SCIENCE EDUCATION

Formerly GENERAL SCIENCE QUARTERLY

SERVING TEACHERS IN ELEMENTARY SCHOOLS,
JUNIOR AND SENIOR HIGH SCHOOLS, COLLEGES,
AND PROFESSIONAL SCHOOLS FOR TEACHERS

VOLUME 31 DECEMBER, 1947 Number 5

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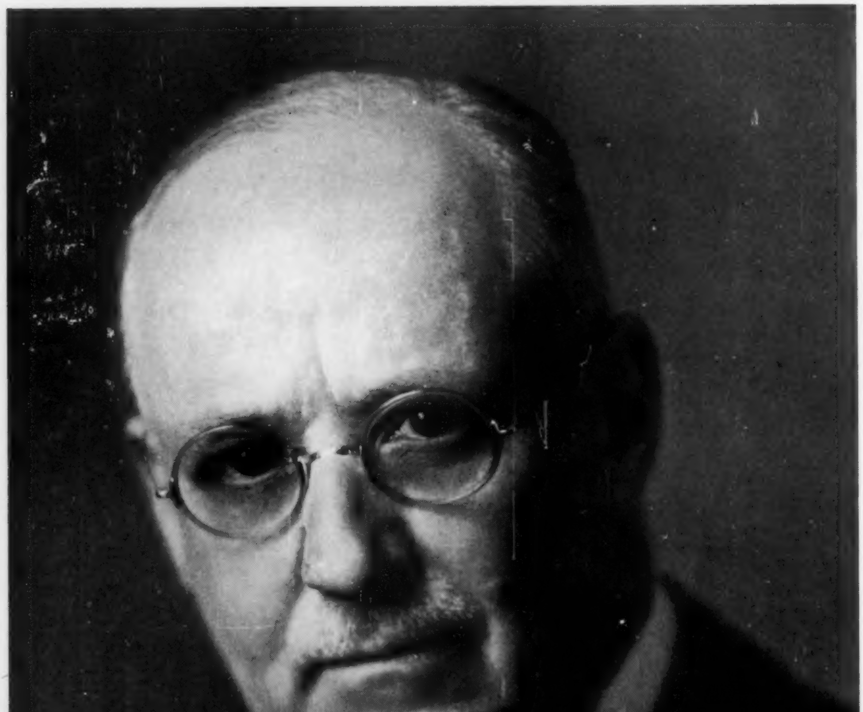


OTIS WILLIAM CALDWELL
(1869–1947)

SCIENCE EDUCATION

VOLUME 31 DECEMBER, 1947 Number 5

OTIS WILLIAM CALDWELL

Otis William Caldwell, General Secretary of the American Association for the Advancement of Science, died July 5, 1947, at his New Milford, Connecticut, home where he had resided since 1931. Here he was stricken with a cerebral hemorrhage while preparing some papers for the Executive Board Meeting of the A.A.A.S. in Washington, July 1–3. This last activity was characteristic of a man who could not spare himself and could never get sufficient rest. Few, if any men, in American science or American education led a more active life than Dr. Caldwell. He always seemed to be engaged in writing a book, preparing a paper, attending a science or education meeting or conference, and in other varied activities as farming and civic obligations. Dr. Caldwell seemingly enjoyed every minute of this strenuous life and his many contacts with his associates.

Born in Lebanon, Indiana, December 18, 1869, Dr. Caldwell received a B.S. degree from Franklin College (Indiana) in 1894 and an honorary LL.D. degree in 1917. He received a Ph.D. degree in Botany from the University of Chicago in 1898. Here he was an instructor in Botany during 1897–1899. He became head of the Biology Department at the Eastern Illinois State Normal School at Charleston in 1899. He returned to the University of Chicago in 1907 as Associate Professor of Botany. Later he became Professor of Botany and Head of Science Teaching, and Dean of the University College 1913–1917. He went to Teachers College, Columbia University, in 1917 as Professor of Education and Director of the Lincoln School. The latter position he retained until 1927. He was Director of the Division of School Experimentation of the Institute of Educational Research 1920–1927, and Director of the School of Experimentation 1927–1935. He became emeritus professor in 1935.

In addition to numerous papers published in various educational and scientific journals, Dr. Caldwell was the author or co-author of *Laboratory and Field Manual of Botany* (1903); *Plant Morphology* (1903); *Practical Botany* (1911 with Bergen); *Introduction to Botany* (1914 with Bergen); *Elementary Botany: Instruction Paper; Elements of General Science* (1918 with Eikenberry); *Gary Public Schools: Science Teaching* (1919); *Biology in the Public Press* (1923 with Finley); *Science Remaking the World* (1923 with Slosson); *Then and Now in Education* (1924 with Courtis); *General Science* (with Eikenberry); *Open Doors to Science* (1926 with Meier); *Elements of General Science: Laboratory Problems* (1926 with Eikenberry and Glenn); *First Course in Botany* (1928 with Pool and Evans); *Introduction to Science* (1929 with Curtis); *Biological Foundations of Education* (1931 with Skinner and Tietz); *An Experimental Study of Superstitions and Other Unfounded Beliefs as Related to Certain Units in General Science* (1932 with Lundeen); *Biology for Today* (1933 and 1939 with Curtis and Sherman); *Do You Believe It?* (1934 with Lundeen); *Science for Today* (1936 with Curtis); *Everyday Science* (1943 with Curtis); *Everyday Biology* (1943 with Curtis and Sherman); Forty-Sixth Yearbook of the National Society for the Study of Education, Part I, *Science Education in American Schools* (1947 with Noll, Brownell, Craig, Curtis and Obourn—and specifically Chapter XVII *Science-Education Imperative*).

A partial list of the organizations in which Dr. Caldwell was a member include: The National Society for the Study of Education, the National Education Association (Chairman of the Committee on Reorganization of Secondary School Science 1915–1920), the Central Association of Science and Mathematics Teachers (President, 1905, 1906), the New York Academy of Sciences, The American Institute of the City of New York (Vice-President and member of Board of Trustees), The New York Society for the Experimental Study of Education (Vice-President), American Society of Naturalists, American Botanical Society, Sigma XI, The National Association of Biology Teachers, the National Science Teachers Association, the National Council of Elementary Science, the American Association for the Advancement of Science (Fellow; Chairman of the Committee on Place of Science in Education since 1924 and General Secretary since 1933), Science Service (Trustee), National Association for Research in Science Teaching (President, 1940, and Honorary Member for life).

In the world of science education few, if any, are more honored than Dr. Caldwell. No person interested in furthering the cause of better science teaching had the wide acquaintance which he had among leaders both in science and in science education. He was one of the early leaders in the field of popularization of science. He clearly saw the need of bridging the gap between what the scientist was doing and accomplishing in his research laboratory and the need of making this knowledge available and understandable to the layman. He brought high courage and an indomitable spirit to his crusading endeavor of making science intelligible to all. As chairman of the Committee on Place of Science in Education and as General Secretary of the A.A.A.S., Dr. Caldwell performed an inestimable service to the advancement of science education. Unswerving loyalty and devotion to both science and education together with a respected scholarship in the pure sciences themselves, gave him a respect and hearing among scientists not possessed by many leaders in the science education field. Appraisal at his full measure in this endeavor must be left to history.

Dr. Caldwell more than any other person can be called the father of General Science. In its early infancy, he did a pioneer and yeoman service in convincing school administrators and teachers of the true values and importance of such a course. The largest enrollment of all pre-college science courses attests to the success of his endeavors. This accomplishment alone would assure Dr. Caldwell of a merited place among all past and present leaders in science education.

Also, as a classroom teacher of science, Dr. Caldwell deserves a high rank among the great teachers of our times. It was the privilege of the writer to have had Dr. Caldwell as one of his instructors at Teachers College. Few teachers surpassed Dr. Caldwell in his ability to state science principles clearly, simply, and challengingly. He emphasized the functional, everyday applications of science, and made the common-place observations most interesting. As he used to say in his classes: "I am always pushing back the boundaries of ignorance—the more I know—the more I don't know. With some of us in some areas (of knowledge) the boundaries are pretty close." "Knowledge must be not only intellectualized but emotionalized. We have not only not begun to make applications of science, but we haven't begun to itch." "You have no right to increase knowledge of truth unless you see the implications of its responsibility."

In his last letter to the writer in early June Dr. Caldwell characteristically lent a note of encouragement by commending the April issue as "an especially good one." Science teachers on all levels have lost a valuable friend and leader.

CLARENCE M. PRUITT

THE PRESENT STATUS OF SCIENCE OBJECTIVES IN THE SECONDARY SCHOOLS OF CALIFORNIA*

George W. Hunter and H. J. Edward Ahrens
Claremont Colleges, Claremont, California

In 1908 a questionnaire was sent by the senior author to 500 high schools in various parts of the United States asking for information regarding the methods, content and purpose of science courses in the high schools. Findings were published in *School Science and Mathematics* Vol. 10, 1910 pages 1–10, 108–111 [1]. In 1923 a second questionnaire was sent out to 1,000 high schools and the results were published in *School Review,* Vol. XXXIII, May and June 1925 [2]. In 1930 a third questionnaire was sent to 1,500 schools. The need for this questionnaire was based on the growth of the junior high schoool idea as well as the findings of various committees on objectives in science. The results of this study were published in *Science Education,* December 1931 [3] and in *School Science and Mathematics,* for February 1933 [4]. In 1940 a fourth questionnaire was sent to 2,600 schools and included all the schools on previous lists as well as the 200 schools involved in the 1936–37 Cooperative Study of Secondary School Standards and to certain progressive schools not in the previous lists. The results of this study were published in *Science Education* December 1941 and February 1942 [5], in *School Science and Mathematics* October 1943 [6], and in *Science Education* February 1944 [7].

In 1947 a similar questionnaire was sent to science teachers in some 1,200 representative junior and senior high schools throughout the state of California. This list included the California schools replying to the 1940 study. The present study was undertaken to determine: (1) the effect of the war on science objectives, (2) to what extent science was being made functional to meet daily needs, and (3) to what extent the objectives followed the newer patterns of educational policy.

Replies were received from a total of 408 teachers representing a geographically broad coverage of the state, both rural and urban. The returns were carefully tabulated under the junior and senior high school levels. No attempt was made to assign weight to the teachers evaluations. It was thought better to present the raw figures and to designate certain significant findings. The objectives, which were those listed in the 1940 study, are shown graphically in the accompanying charts according to the emphasis placed upon them in the classroom. That is, the objective having the greatest percentage of occurrence was placed first; the objective having the next highest percentage was placed second; and so on for the complete list of thirty. In order that a direct comparison could be made with the objectives used in the 1940 study the raw data from the California schools in that study were tabulated in a similar manner.

These general objectives were then grouped as follows: (1) those which dealt with the scientific method; (2) the functional group, and (3) those which in lieu of a better title are classed as miscellaneous. The results of the analysis can be found in the two tables which follow. Table I gives the place of emphasis and the change to present status for the junior high schools responding. Table II gives the same information for the senior high schools. Tables III and IV show the distribution of the objectives for the junior high schools of California in 1940 and 1947 respectively; while Table V and Table VI give the same

* This study was made possible by a grant from the Joint Research Committee of the Associated Colleges at Claremont, California.

TABLE I

PLACE OF EMPHASIS AND THE CHANGE TO PRESENT STATUS OF OBJECTIVES AT THE JUNIOR HIGH SCHOOL LEVEL

Objective	*A* *Status 1940 Placement*	*B* *Status 1947 Placement*	*C* *Alteration*	*D* *Total Change*
I. Scientific Method and Concomitants				
1. Scientific method	22	12	+10	
2. withhold conclusions until facts secured	11	16	− 5	
3. evaluate and interpret data	16	22	− 6	
4. fact finding technique	23	15	+ 8	
5. the "power" of observation	3	6	− 3	
6. attitude free from dogma and superstition	6	4	+ 2	
7. control and experimental factor	25	26	− 1	
8. formulate hypotheses	28	28	0	
9. facts of science used in making generalizations	15	20	− 5	
10. information useful in solving life problems	12	8	+ 4	
11. accuracy and neatness in all operations	14	13	+ 1	
12. worthwhile ideals and habits	8	5	+ 3	
13. generalizations of science	26	24	+ 2	+10
II. Functional				
14. conservation of natural resources	5	10	− 5	
15. consumer education	24	21	+ 3	
16. functional adjustment	10	25	−15	
17. knowledge of science in community life	7	11	− 4	
18. understanding of personal health needs	9	3	+ 6	
19. knowledge of the environment	2	2	0	
20. understanding the environment	1	1	0	
21. appreciation of environment	4	7	− 3	
22. worthy use of leisure time	20	23	− 3	−21
III. Miscellaneous				
23. factual science material	27	19	+ 8	
24. exploratory experiences	17	14	+ 3	
25. election of later courses	20	23	− 3	
26. preparation for college	30	29	+ 1	
27. vocational training	29	30	− 1	
28. appreciation for work of scientists	18	17	+ 1	
29. foster democracy	13	9	+ 4	
30. selection of worthwhile scientific reading	19	18	+ 1	+14

information for the senior high schools of California in 1940 and 1947.*

It is seen from Tables I and IV that science at the junior high level is based to a considerable degree upon the environment. "Understanding the environment" stands at first place while the two objectives, "knowledge of" and "appreciation of the environment" hold a place of relatively high importance. The functional objectives have shown a considerable shift as individual objectives and as a group have shown a general decrease since 1940. Emphasis on scientific method has shown the greatest increase in importance. The attitudes and techniques of the scientists have also increased in importance in the classroom. The teaching of factual science has shown the next largest increase of all the objectives. It is interesting to note that since the war college entrance has become a more

* The graphs to the right of center in figures show objectives stressed; those to the left show objectives not stressed in teaching.

TABLE II

PLACE OF EMPHASIS AND THE CHANGE TO PRESENT STATUS OF OBJECTIVES AT THE SENIOR HIGH SCHOOL LEVEL

Objective	*A* *Status 1940 Placement*	*B* *Status 1947 Placement*	*C* *Alteration*	*D* *Total Change*
I. Scientific Method and Concomitants				
1. Scientific method	3	1	+ 2	
2. withhold conclusions until facts secured	10	7	+ 3	
3. evaluate and interpret data	8	12	− 4	
4. fact finding technique	18	13	+ 5	
5. the "power" of observation	5	6	− 1	
6. attitude free from dogma and superstition	7	10	− 3	
7. control and experimental factor	24	20	+ 4	
8. formulate hypotheses	29	28	+ 1	
9. facts of science used in making generalizations	17	17	0	
10. information useful in solving life problems	11	8	+ 3	
11. accuracy and neatness in all operations	16	11	+ 5	
12. worthwhile ideals and habits	4	2	+ 2	
13. generalizations of science	28	26	+ 2	+19
II. Functional				
14. conservation of natural resources	14	21	− 7	
15. consumer education	13	22	− 9	
16. functional adjustment	12	14	− 2	
17. knowledge of science in community life	15	16	− 1	
18. understanding of personal health needs	1	4	− 3	
19. knowledge of the environment	6	5	+ 1	
20. understanding the environment	2	3	− 1	
21. appreciation of environment	9	9	0	
22. worthy use of leisure time	26	24	+ 2	−20
III. Miscellaneous				
23. factual science material	25	15	+10	
24. exploratory experiences	22	23	− 1	
25. election of later courses	30	25	+ 5	
26. preparation for college	21	18	+ 3	
27. vocational training	23	30	− 7	
28. appreciation for work of scientists	27	29	− 2	
29. foster democracy	19	19	0	
30. selection of worthwhile scientific reading	20	20	0	+ 8

important objective at both the junior and senior high levels. This apparently is due in part to a holdover from war time demands [8].

The present study shows that at senior high level the scientific method as an objective holds first place in rank of emphasis and has increased in importance since 1940. The methods of science hold a place of greater importance than before. On the other hand this is to be expected in view of the emphasis placed on the teaching of this method by such writers as Noll and others [9], [10], [11]. The functional group at both junior and senior levels has shown a decrease in teaching emphasis. This is not understandable in view of the emphasis on functional teaching at the present time [12], [13]. "Consumer education", "conservation of natural resources", and "worthy use of leisure time" which should be of importance to high school pupils, particularly those for whom formal education is terminated, hold a place

TABLE III

OBJECTIVES OF JUNIOR HIGH SCHOOL SCIENCE—1941

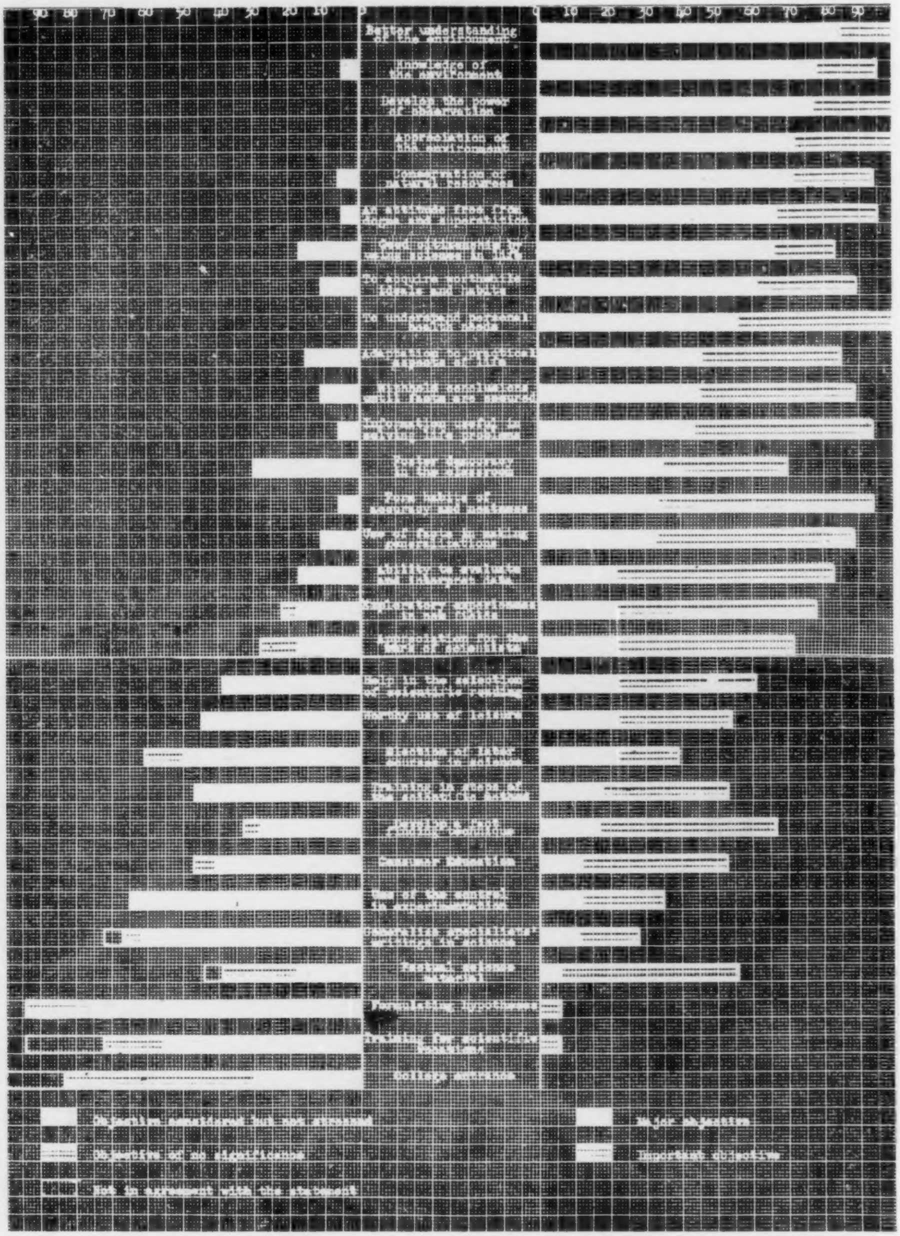


TABLE IV
OBJECTIVES OF JUNIOR HIGH SCHOOL SCIENCE—1947

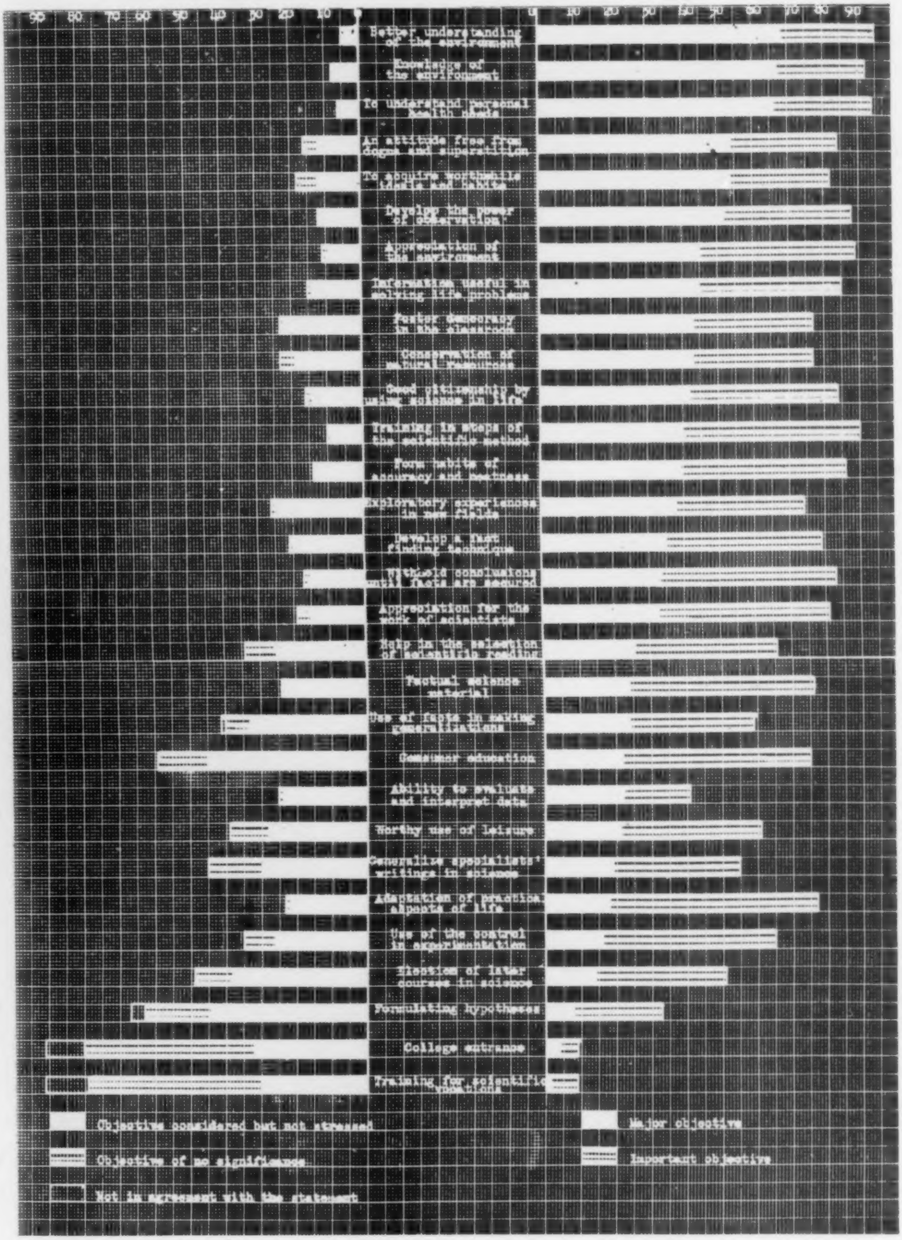


TABLE V
OBJECTIVES OF SENIOR HIGH SCHOOL SCIENCE—1941

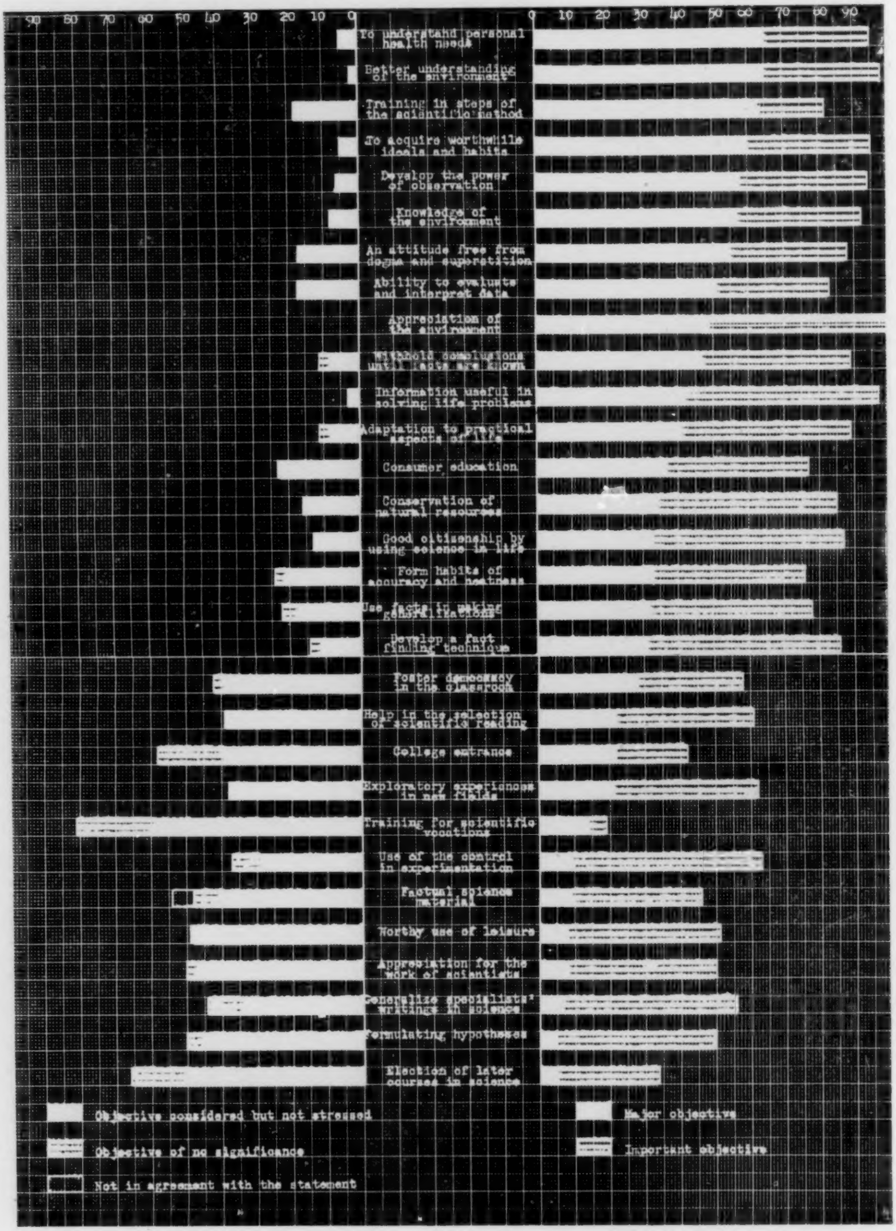
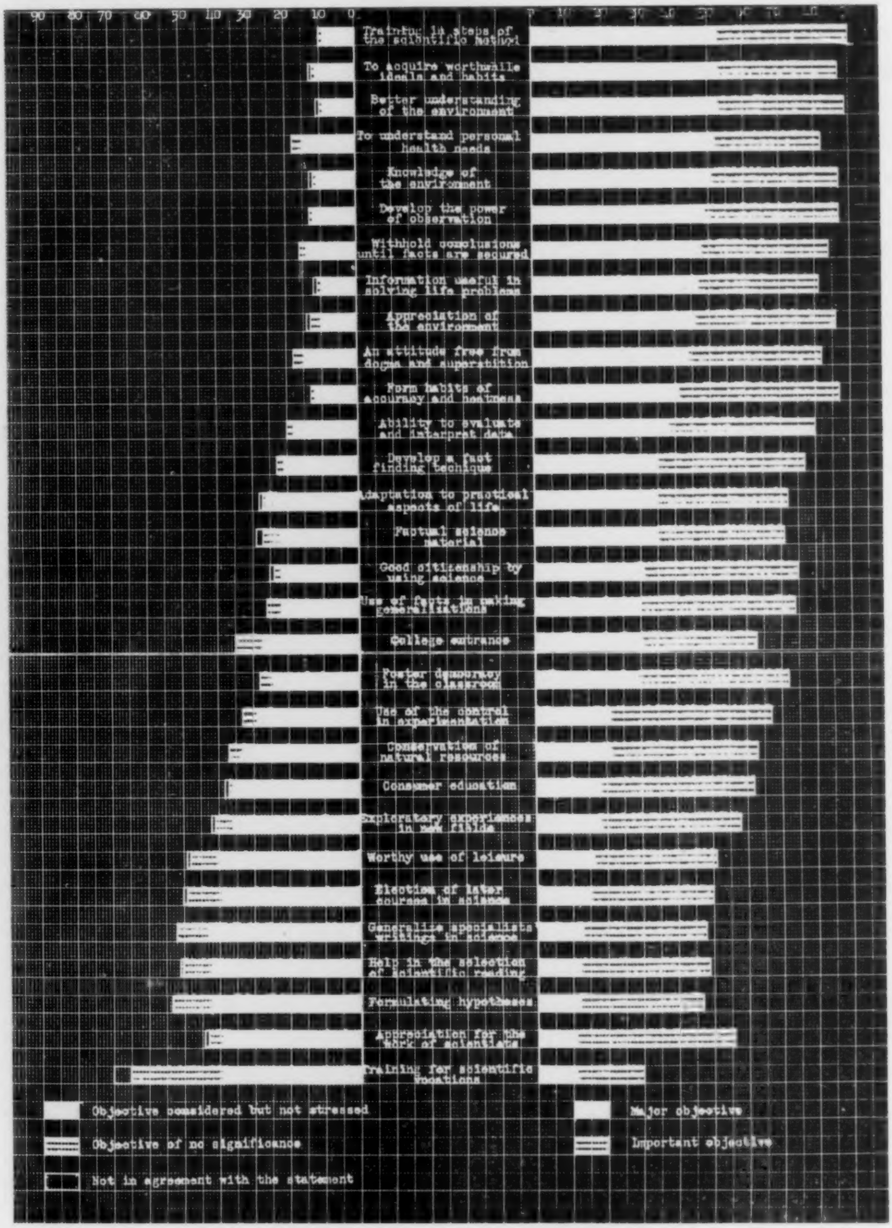


TABLE VI
OBJECTIVES OF SENIOR HIGH SCHOOL SCIENCE—1947



of little significance. On the other hand the health and the three environmental objectives still remain at a high level of emphasis.

It is difficult to determine the exact degree that the war has had on science instruction. However, a fair degree of evidence is to be had from the questionnaire and from interviews with teachers, which shows that the more rigid preparation demanded by the army is not being continued. At the present time, however, there are more offerings in "radio", "aviation" and related fields of specialized or vocational science. It is understood that the State Department of California is now working on an aviation program to be introduced in the public schools this fall. These are no doubt a carry over of the influence of the war plus the demands of commercial aviation. It would seem that the increased use of the factual knowledge objective at both the secondary levels, has a direct association with the courses offered in military and pre-induction training during the war years.

There is little doubt that science can be made functional, for current educational literature is filled with plans of meeting student needs in a functional manner [14], [15], [16]. At both the junior and senior high school levels the evidence seems to show that these needs are not being met in present day science teaching. The functional objectives as a group have shown a decrease in importance as a classroom objective in California schools. The learning process is linked to a considerable degree with its functional aspect when one considers its dependency upon motivation.

A comparison of objectives cited as important in 1940 and 1946 in the schools of California shows a considerable spread in the number of objectives at this later date. More of the objectives deemed worthwhile are the socialized and humanized side of science. In addition those having to do with the psychology of learning are mentioned as important. In general, the pattern of science education seems to follow more closely the newer concepts of child growth and development. In several instances specific mention was made in regards to the individual differences of the pupils. Concepts and generalizations are formed by taking an objective reality, centering discussion around it as a problem in thinking and then solving the problem. Science teachers have become aware of the fact that scientific attitudes are not concomitant of laboratory study but if developed from a study of science they must be taught directly.

In conclusion it can be said that while the science instruction in California is meeting the needs of individual pupils to a certain degree, there is a striking need for thoughtful improvement in many schools. In some schools certain unworthy objectives are rated high, while the "needs" approach is almost purely a "lip service". Teachers are content with the type of teaching that embraces "faculty psychology" rather than the newer psychology with its broadened understandings of the learning pattern. The materials for the improvement of classroom methods and objectives have been and are available, but there is apparently a lack of awareness or desire on the part of many teachers to take advantage of these helps. The situation differs in many schools and some are doing a far better job than others. The rural schools of California, with less favorable material conditions, are making a better science curriculum than are many urban schools. The increase in the "factual knowledge" and propaedeutic objectives bears consideration and watching. This may well be a step backwards toward a more conservative type of science program. Science is closely related if not responsible for many of the conditions confronting us in modern life. Involved in this fundamental relationship lies an obligation for science to share in making effective the adjustments of boys and girls to the conditions it in part has created. If science is to take the lead in a new educational program it

must be a science that relates more closely than in the past to the material and social aspects of ordinary life.

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The Forty-Sixth Yearbook of the National Society for the Study of Education, Part I

SCIENCE EDUCATION IN AMERICAN SCHOOLS*

VICTOR H. NOLL

Michigan State College, East Lansing, Michigan

POLICIES AND PROCEDURES

IN accepting responsibility for the yearbook on science education the Committee[1] was faced with the task of preparing it in an unusually short time. The undertaking was authorized in October, 1945, and the chairman was invited to get a committee together and go to work. The first meeting of the full committee was held in November of the same year. Three subsequent meetings, each for three days, were held in February, June, and August, 1946, respectively. Every member of the committee attended all meetings for the full time excepting the last when one member was prevented by illness from being present. No committee could have worked

* Papers by Victor H. Noll, J. Darrell Barnard, Glenn O. Blough, Eugene B. Elliott, J. Cayce Morrison and Samuel Ralph Powers were presented at the March 3, 1947, Atlantic City meeting of the National Society for the Study of Education.

[1] W. A. Brownell, Duke University; Otis W. Caldwell, American Association for the Advancement of Science; G. S. Craig, Teachers College; F. D. Curtis, University of Michigan; V. H. Noll, Michigan State College, Chairman; E. S. Obourn, John Burroughs School.

harder or more faithfully and I wish to acknowledge at this time their excellent cooperation and continued devotion to the task. I should also like to express appreciation to the Directors of the Society who have been generous in providing funds for the work of the committee, and to Dr. Nelson B. Henry, Secretary, who has been untiring in his efforts to aid and facilitate our progress.

I think science teachers and scientists, far from being hardheaded and impersonal, often are the most idealistic of people. At the first meeting it was unanimously agreed that this should in truth be a committee report and that no portion written by a member of the committee should be specifically credited to him. Although this compact was entered into on a lofty plane it had a realistic aspect since it meant that every member had to approve what went into the report and thus gave him in effect the power of the veto. It is to the credit of the committee that this veto power was never used except in the form of constructive criticism. However, had the chairman been less innocent of the tasks and problems of yearbook committees and had he foreseen the trials and tribulations in store for him in securing approval of manuscripts under these conditions he might have raised strenuous objections or resigned on the spot. The arrangement described, it should be added, did not hold for invited contributors who are specifically credited for their contributions, although each one's work was read and finally approved by every member of the committee. The closing chapter also constitutes an exception in that the committee chose to honor its distinguished senior member, Dr. Caldwell, by giving him carte blanche to write as he pleased and to credit him with authorship.

The yearbook, is then, in fact a committee report. Every word in it was read by every member, discussed and criticized both through correspondence and in conference, revised, and read again. Some portions were read, criticized and revised no less than four times. There may be some details over which we might have haggled endlessly though I could not now cite any such, but in the larger aspects, in point of view, and in recommendations of procedure for future progress, we are, like the three musketeers, all for one and one for all. Anyone, therefore, who might decide to assail the report had better reckon carefully on the desirability of an encounter in which he would probably find himself arrayed single-handed against the united front of a committee of six. Nevertheless, we welcome criticism, as we hope we shall have ample opportunity to demonstrate later this evening.

Purposes and Scope of the Yearbook

Probably none in this audience is interested in a detailed review of the report presented here tonight. However, since most members of the Society have not seen it, a brief statement of the purposes and scope of the report may not be out of place. The other speakers have had page proof and will refer to specific parts of it if they deem that appropriate.

A number of considerations made desirable at this time a yearbook dealing with the teaching of science. Among these are, (a) scientific progress and its effects on the world scene; (b) new developments in science instruction including such things as the growth of organized instruction in science in the elementary school, the increased offering and enrollments in such courses as Senior Science, Physical Science, etc., at the senior high school level, and (c) the accumulation of a considerable amount of research data over the past two decades dealing with instructional problems in science.

In the light of such developments the purposes of the yearbook may be stated as follows:

A. To present a challenging and workable philosophy of science teaching

which will assist and encourage teachers of science to make the contribution to the welfare of society which they, through their work and other activities can make, and which society looks to them to make. As a means to this end, the commitee throughout the report adhered to the following principles:

(1) To make the report as practical as possible. It was our aim to present the material from the viewpoint of the classroom teacher and to show how daily activities of classroom and laboratory can be made to contribute to the ultimate goals of education in a democracy.

(2) To review and appraise available research in science teaching and to suggest desirable types of, and direction for, further study.

(3) To select and describe the best practices in science teaching that could be found and to show how they can be adapted to daily use by any qualified teacher who is interested in improvement.

B. Another important purpose of this report stems from the movements and trends to which reference has just been made. New kinds of courses and new methods and devices in science instruction are being developed in many places. It was our purpose to examine these developments, to appraise them, and to determine, insofar as possible, what their implications for the future seem to be.

In the preparation of the yearbook all elementary and secondary grades, including the thirteenth and fourteenth, were considered. The report includes a discussion of what the Committee feels to be desirable objectives of science instruction, both in the ultimate and in the more immediate sense. Science as a field of instruction is oriented in the direction of its functions in modern society. Recurring problems as persistent issues are briefly discussed and the best collective judgment of the yearbook committee is presented on each issue.

An entire section of the report deals with problems of science teaching in the elementary grades including discussions of methods and materials, multi-sensory aids, evaluation, education of teachers for this level, and of significant research.

Another section, organized in a similar way and dealing with these problems at the secondary level constitutes a substantial share of the report. A closing chapter attempts to envisage the future services which instruction in science can render.

RECOMMENDATIONS FOR NEXT STEPS

The yearbook contains much that is indicative of progress in science education at elementary and secondary levels. Throughout the volume successful methods of teaching and evaluation are described. In the last chapter many suggestions for future progress are outlined, though for the most part in general terms. Indeed, the whole report is, in a real sense, a plan of action for science teachers. However, it seems worth the attempt to point out rather specifically what seem to be desirable lines for future progress. This I should like to try to do very briefly.

1. The method of science should become the procedure employed generally, indeed, universally in solving the problems facing our civilization. To say that science teaching should be functional is another way of stating that it must be conducted in such a way that children and adults will *use* what they learn in science; that scientific attitudes will be developed which really affect the way in which they think and act; that they will not only develop skill in problem solving but also the *disposition to use* the scientific method in place of less effective procedures. It is recognized, of course, that science education cannot alone accomplish this. It is maintained however

that it has a great contribution to make in cooperation with other parts of the instructional program.

2. The second point develops logically from the first. Science as a subject of instruction should be accorded a pre-eminent place in the curriculum of elementary and secondary schools. This *is* an age of science and successful living in it and the solution of problems facing humanity require a knowledge and an understanding of science. Too many children still leave our schools without having had even one organized course of instruction in science. There is at the present time a desperate need for wider dissemination and acceptance of science knowledge. The problems we face are largely due to ignorance of science and to failure to utilize it to the worthier ends. The remedy for ignorance and resistance to progress is not *less* science, as some would have us believe, but *more* science. It is not to be found in a reduction of the scope and importance of the place accorded science instruction in the curriculum but rather a recognition of the fundamental and pre-eminent place that science occupies in our world. Wider dissemination of scientific knowledge can only be achieved through provision of adequate time for, and attention to, instruction in science at all levels from kindergarten to university.

In a manuscript shortly to be published, that champion of adequate recognition of science in the curriculum, Franklin J. Bobbitt, puts the matter thus:

"Things of large value should have large place in the curriculum; and things of small value, correspondingly small place. Things imperative should be central.

. . . . Of the studies, science in its several aspects is incomparably the thing of greatest immediate need—greater than all others put together. And the fact that both laymen's science and specialist's science are absolutely indispensable puts it at the center of the program. Whether the curriculum be academic or functional, clearly the intellectual aspects of the program should be mainly and basically science. The stone that has been neglected by the builders should be made the head of the corner. In the program of the modern school, science, and the applications of science, should tower over everything else. Its place should be vastly expanded. If the educational program must anywhere be whittled down because of hampering conditions, science is the last thing, excepting only literacy, to be touched."

3. It follows that meeting this challenge successfully will require far better instruction in science than on the average now obtains. At the elementary level, many teachers are seriously lacking in science background. At the high school level, there is abundant evidence to show that many high school teachers are attempting to give instruction in science courses without adequate training in subject matter or methods.

Perhaps even more important than the lack of specific preparation for science teaching is the lack on the part of many science teachers of adequate understanding of the role of science instruction in solving problems of vital importance. It is probably not their fault that they fail to see very far beyond the boundaries of their subject-matter. The kind of programs for their education outlined in Chapters X and XV of the yearbook are not the sort which the average science teacher has experienced. They have not been brought to a realization of their potential contribution as leaders in school and community for which their training in science should prepare them. In this day and age, no teachers would seem to be better qualified to exercise leadership than teachers of science. Those responsible for their education should see to it that they have the knowledge, the techniques, the vision and perhaps above all, the will to do the job. Without these they cannot and should not be expected to meet the challenge.

4. There is need for a comprehensive

and continuing attack on many problems of science instruction. Much research is needed on fundamental problems. Such a program should be national in scope and it should encourage participation and contributions from all interested persons and agencies. It should provide for recognition and inclusion in its planning of all going research in this area wherever practicable. The active cooperation should be sought of independent organizations such as research bureaus of city school systems and of higher institutions, of school administrators, classroom teachers and specialists in science education, and of representatives of industry, business and the social sciences. Support, financial and otherwise, for such a program should be generous and freely provided in keeping with the potential contributions of the undertaking.

A program such as is here envisaged should have the confidence and support of lay persons and organizations as well as professional groups. It should interpret the purposes and methods of science education to those who need to know them. A concerted attack on fundamental problems of science instruction should contribute greatly to the increased achievement of the important objectives set forth in this report. Moreover, it would serve to show that science instruction practices what it preaches—the practical effective application of the scientific method to its own problems.

5. Finally, those engaged in science teaching particularly, but all educated persons, scientific organizations, and government agencies as well, should by every possible means, attempt to interest young people in science, either as a career or as an integral part of their general education. Talented young men and women should be encouraged and be given all necessary assistance to prepare for careers in science as teachers, research workers, writers or other types of specialists in science. It is of the utmost importance to our future welfare as a people that the two-fold function of science for the layman and for the future specialist be kept constantly in view. The rewards in terms of the common good will richly repay any effort made.

Mr. Chairman, on behalf of the responsible committee I have the honor to present The Forty-sixth Yearbook, Part I, entitled *Science Education in American Schools.* Into the volume have gone the best individual and collective thought and endeavor of the committee and those associated with us as invited contributors. It is our earnest hope that our report may be pleasing to you and others who read it, and that it may prove to be a substantial and significant contribution to the literature of our profession.

ANNOUNCEMENT

The annual luncheon of the National Science Teachers Association will be held in the Club Room of the Hotel Sherman, Chicago, Illinois, at 12:30 noon on Monday, December 29, 1947. The program will include a tribute to the life and work of Otis William Caldwell. The speaker will be Dr. Harlow Shapley, President of the American Association for the Advancement of Science.

Tickets may be obtained by writing to Nathan Neal, 49 East 33rd Street, New York 16, New York. During the convention, tickets may be obtained at the ticket booth in the Hotel Sherman or in the Stevens Hotel.

THE YEARBOOK AS IT RELATES TO SCIENCE INSTRUCTION IN THE SECONDARY GRADES

J. Darrell Barnard

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We are constantly reminded of the tremendous advances which have been made in the knowledge and application of science. Never in the history of mankind has science held the position of interest and concern which it holds today. We would expect this interest to be reflected in the enrollments in science classes at the secondary school level. This is not the case. Although the actual number of students enrolled in secondary-school science classes has increased, the per cent of total secondary-school students enrolled in science classes has continued to decline. The publication of the Yearbook on *Science Education in American Schools* comes at a most appropriate time. Science instruction at the secondary-school level is in great need of critical evaluation and orientation in terms of the direction it should take in the future.

All of us, who are concerned with science instruction in the secondary grades, have been looking forward to this Yearbook with a great deal of anticipation. None of us, and least of all the committee, expects this report to be the final authority on secondary-school science. We do expect it to represent the best thinking in the field of science education to date. We expect it to present a critical evaluation of science instruction in the secondary school in terms of currently accepted educational theory. We know that it will point the way in science education for some years to come. Its influence may extend to all secondary schools throughout the nation. It has the potentiality of being the most influential document yet published in science education. It is for these reasons that we have anxiously anticipated its publication.

Those who are responsible for the education of prospective secondary-school science teachers are anxious to evaluate their programs in terms of the committee recommendations. Producers of instructional materials for secondary-school science are eager to know what effect the report will have upon the use of their materials. Curriculum committees may find it advisable to reevaluate much of their work, or they may be encouraged to move on with renewed assurance, when the report is finally available to them. And, finally the science teacher himself may be wondering what unusual fads and fancies this new publication will promote that will further complicate his work as a science teacher.

In preparing Section III of the Yearbook, it is evident that the committee has attempted to examine the secondary-school science program in the light of currently accepted educational theory; to identify the conditions which need to be improved; and, to make practical suggestions as to how these improvements might be accomplished. The science teacher, who is concerned about improving his teaching, will obtain a great deal of down-to-the-earth, practical help from this section of the report. The trends and objectives in secondary school science are presented in the first chapter of the section. This is followed by a chapter dealing with the content and methods of science in the junior high school. Special problems of science teaching at the secondary level are taken up in the third chapter of this section. Next, the evaluation of instruction in science is treated. Finally, the problem of educating the prospective science teacher is discussed and recommendations of the committee are presented in conclusion.

Rather than review each of these chapters, the following ideas, which seem to be most pertinent for science instruction in the secondary grades, will be discussed briefly:

1. The first and most important concern

of science education in the secondary school should be the general education of young people.
2. Science courses should be organized and taught with the primary intention of modifying student behavior so that the student may cope with his everyday problems more effectively.
3. The abilities and needs of secondary-school students must be given basic consideration in the science program at that level.
4. There is no one general method of teaching science. The learning experience which accomplishes the objective in a minimum of time and energy is the important thing.
5. Science education at the secondary level can be improved without completely reorganizing the pattern of science courses.
6. The education of the prospective science teacher should include an opportunity to understand the social implications of science and the nature of the learning process.

The Committee considers the first and most important concern of science instruction in the secondary grades to be that of general education. Science teachers, who are looking for an organized outline of subjectmatter to be taught in such a general education program, will be disappointed in the Yearbook. There is no such outline nor will they find the mere suggestion of one. The Committee emphasizes the importance of functional facts, concepts, and principles in the general education of young people. They do not attempt to present an organized list of the facts, concepts, and principles which they consider essential for the general education of everyone at the secondary level. Instead they suggest general areas of human adjustment in which it would be desirable for young people in the secondary-school science program to have problem-solving experiences. Health, consumership, conservation, family relations, and vocation are among the areas suggested. The nature of the problems which students will study in these areas will determine what facts, concepts, and principles are to be taught.

Secondary-school science courses, such as general science and biology, which have had greatest appeal to students, have provided experiences in these general areas of adjustment. The nature of these courses lends itself to this functional approach. Attempts to functionalize chemistry and physics in this manner have been least successful. A sacredness of subject-matter organization, especially in physics, has thwarted attempts to reorganize learning experiences in these courses as freely as has been done in general science and biology. To some extent, this inflexibility accounts for the proportionately lower enrollments in these courses. Other courses have been organized at the senior high-school level to make up for the failure of chemistry and physics to provide suitable experiences in general education. These generalized courses in physical science, at the senior high school level, have experienced some difficulty in getting started, but are becoming more popular. Generalized courses such as these have been sanctioned by nationally recognized committees on general education. Some institutions of higher learning have also approved the generalized science courses as meeting the entrance requirements for non-science majors. These instances have added impetus to the development of generalized courses in physical science. Although the trend is definitely toward general education, the committee believes that there is still some need for specialized science courses in the secondary schools.

That science education should modify the behavior of students so that they can cope with their personal and social problems more effectively, is stressed throughout the section of the Yearbook on secondary-school science. Three of the eight general

objectives are defined specifically as behaviors. Instrumental skills, skills in the elements of problem solving, and the development of scientific attitudes are analyzed into the specific things that one would be able to do, had he achieved these objectives. The description which is given of these specific actions or behaviors makes teaching for them much more purposeful. In the past indefinite statements of objectives, have to a large degree accounted for the failure of teachers to teach for them. The specific ways in which the first three objectives, functional facts, concepts and principles, would or should modify behavior was not made clear. How will we know when behavior changes are realized from functional facts, concepts, and principles until we know what behaviors are supposed to be changed? The last two objectives, appreciations and interest, are also vague with regard to the behavior changes they will bring about. To illustrate, just how is an appreciation of the contribution of science in the progress of civilization going to modify behavior? How is an appreciation of the manifold applications of science through invention going to modify behavior? Before we can go very far toward teaching science to modify behavior, we must know specifically what kind of behavior we are trying to achieve.

Throughout the report repeated reference has been made to the importance of considering students' abilities and needs in organizing and teaching science courses. The findings of research are presented which show that many of the printed materials in science are too difficult for the age level of students to be taught, and should therefore be simplified. Even within a specific grade level there is a wide range of student ability. Attention, then, should be given to providing experiences of varying degrees of difficulty for each grade level. Time and again it was pointed out that the average secondary-school science teacher tries to cover too much ground. As a result understanding is superficial and nonfunctional. Fewer problems, topics, units, or principles should be taught, and the learning experiences should be planned to achieve the understanding commensurate with the grade level.

The needs of young people should be given special consideration in defining the areas in which experiences in science should be provided. Student needs should also be basic in the selection and organization of content. As yet there is no reliable list of common needs of young people at the secondary-school level. Suggestions of the ways in which science teachers could go about determining the specific needs of their students would have been most appropriate. There must be some more reliable means of determining these needs than the intuition of the teacher.

The importance of selecting students with special abilities in science and providing them with a special kind of education, is brought out in the report. The activities of science clubs are also described as a means of providing for special needs not met in the classroom.

The report emphasizes the point of view that there is no one general method of teaching science. There are many different kinds of learning experiences which might accomplish the desired objective. The teacher should select the experience which accomplishes the objective in a minimum of time and with a minimum of energy. Teachers will find the descriptions of the many different types of learning experiences, reported in the Yearbook, to be most helpful. They should not only be able to use many of the learning experiences described, but the descriptions should stimulate their imagination to devise similar ones of their own. Many different techniques for developing abilities in problem solving are described such as: sensing and defining problems, collecting and evaluating data, formulating hypotheses, testing hypotheses, and accepting conclusions.

In no place throughout this section of the report does the committee recommend that established science courses in the secondary school be discarded as a means of improving science education. Neither does it recommend that new courses be introduced. The problem of improving science education has been approached from a practical point of view. All suggested ways of improving science instruction are made with reference to a course pattern of general science in Grades VII, VIII, and IX, biology in Grade X, generalized physical science, chemistry or physics in Grades XI and XII, and the survey courses in biological and physical science at the junior college level.

It is evident that the science teacher will determine to a large extent whether or not science education at the secondary level will be improved in accordance with the recommendations of the committee. It is pointed out in the report that science has not been adequately represented in the core curriculum of the high school. The inability of the science teacher to interpret science in terms of its social implications is one of the reasons for this condition. Although many science teachers have strong backgrounds in the subject-matter of science, comparatively few of them are able to plan learning experiences which would develop abilities in problem solving. It is interesting to note that more students take general science than any other one science course in the secondary school, and yet general science teachers are the most poorly prepared. One of the most serious problems, in teaching survey science courses at the junior college level, is obtaining qualified instructors.

The importance of science in programs of adult education is also brought out, but it is admitted that most science teachers are not qualified to assume this responsibility. They lack the insight necessary to deal with social implications of science. They have not been able to keep up adequately with recent developments in science so that they can deal with such subjects in adult groups.

Many science teachers fail to adjust their programs of instruction to the needs and abilities of their students. Much of this is accounted for by a lack of understanding of the learning process and the nature of human growth and development.

In view of these deficiencies of science teachers, a program for the pre-service education of teachers is outlined. The committee recommends that one-half of the pre-service education of the secondary science teacher be in science. It is further recommended that survey or integrated courses in physical and biological science make up a substantial part of the teacher's preparation in science. The remainder of his college preparation should be given over to survey or integrated courses in social studies, courses in the arts, human growth and development, learning, evaluation, guidance, and teaching. His college courses, especially in science, should provide abundant opportunity to use problem solving skills.

The committee should be commended for this report. It provides a basis for secondary-school science teachers to interpret the present status of science education in terms of recent trends and possible future development. It relates currently accepted educational theory at the secondary level to science education. It presents many practical ways in which practices in science teaching can be brought closer to accepted theory. The function of research in the improvement of science education is effectively brought out in the report. Problems which need further investigation are identified in relationship to the total program of science education. This report points the way, presents the challenge, and provides some of the ideas for the future improvement of science education at the secondary level.

THE YEARBOOK AS IT RELATES TO SCIENCE INSTRUCTION IN THE ELEMENTARY GRADES

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THE increased allotment of space devoted to a consideration of science teaching in the elementary school, compared with that allocated to it in the 31st Yearbook may be considered indicative of the growth in importance of this phase of science teaching since the earlier Yearbook was issued.

Since the appearance of the 31st Yearbook there has been an ever increasing interest in science at the elementary school level. Numerous school systems, large and small, have now included it in their offerings to grade-school children. More and more material has been prepared for the use of teachers. New courses of study and bulletins have been issued by State Departments and by county and city schools. The guidance extended by the committee through the writing of this Yearbook will be of inestimable assistance to all who are concerned with administering the science program at the elementary level.

Teachers and others conversant with the thinking in this field over a period of years, will find certain very significant advances in thinking indicated in the new Yearbook. The basic purpose for teaching science in the early years of children's school experiences remains the same. Certain advances in fundamental convictions regarding some of the aspects of the problems involved are however evident to the reader of the 46th Yearbook.

The Committee has indicated in various sections of the discussion the great importance of a knowledge of child growth and development as a background for planning and administering the program in elementary science. The research findings regarding the learning process of the young child, his patterns of development, his urges, his abilities, his satisfactions and similar aspects of child development must be known to those who plan, and administer the science program for young children.

Repeatedly the Committee urges that the science program be examined in relation to its contributions to the social needs of the child. Change in social behavior can be influenced to a very large extent through a carefully planned science program which considers itself in proper relationship to the total school program. The Committee urges that we not only consider a balance in the science program itself, but step farther toward serving the needs of the child by learning what the total program for the elementary school shall be and by gearing the science phase of the program to fit this total educational scheme. In order to fit into this broader education process, the science program must be "Organized around problems that have social value and are challenging and worthwhile to children." And "opportunities must be provided for the development of understandings in all the areas of the environment and at all levels of social needs." Those who accept this recommendation of the committee must indeed examine their present science programs carefully with respect to science content, methods of teaching it, activities engaged in, and evaluations made. It will be necessary for teachers and others to do a large amount of cooperative planning if the total school program is to be integrated to achieve the broad general goals of elementary education.

It is perhaps of more than passing interest to note that the Committee has seen fit to include sections dealing with the very young child, i.e., the pre-school child. Much has been learned about the developmental

process at this early level, much that is important in interpreting the child's actions and reactions as he continues to grow and develop. This glance at the very young child is in line with the wider look to see the total picture of the child which is emphasized by the Committee.

There is an increased emphasis on the importance of the use of community resources in teaching elementary science. The total community as a source of useful materials and information is emphasized. There is a very practical section devoted to methods of obtaining materials of instruction which will be useful to school systems that feel that lack of equipment is one of their chief handicaps. A section on rural schools and one on urban schools treat this problem in a very practical and helpful nature.

In addition to some of these general trends briefly mentioned, are also certain specific statements found in the Yearbook which merit mention either because they are salient points useful in planning a program or because they represent ideas which need further development to forestall misinterpretation by the uninitiated reader.

One such statement concerns the use of the steps in the scientific method in the elementary school: "In the elementary school there are relatively few times when it is appropriate to solve problems through the use of all of the elements of the scientific methods listed for use in the high school." Experienced teachers in elementary school science will heartily agree with this. Perhaps we may go a step farther to ask ourselves if we have also in some instances written down for use in grade school content material appropriate to the high school level but highly inappropriate for younger children. Above all, our elementary science content should be selected on the basis of what it can contribute to elementary children and not a written-down high school science course. Perhaps a reexamination of our elementary science course with respect to this point of view will make it possible to take more time with the material which then remains and thus feel less hurried to cover the course as outlined.

A statement which should give pause to all concerned with science teaching at any level is: "It has often been noted that maturing children seem to lose some of their zest for inquiry." This has long been obvious to those who have dealt directly with science classes in the elementary school and who know also the high school classes. It is hard to believe that this loss is not due very largely to our method of instruction, our failure to challenge the minds of learners and to broaden their interests and curiosities. Here indeed is food for thought for those who plan and teach.

In discussing the relationship which the child's imagination contributes to his understanding of science, the Committee stresses the importance of using this imaginative nature of child behavior. The experienced science teacher will do well to differentiate clearly between the place where imagination as a useful tool ends, and where the necessity for supporting evidence begins. Many children in our elementary schools arrive late at the stage of development in which they are able so to differentiate and the skillful science teacher may contribute materially to these children. In this connection the Committee also indicates the use of dramatics as a tool for "developing certain attitudes and traits." The writer goes on to say that: "While dramatics is only one form of doing, it is emphasized because dramatics play reaches its peak of spontaneity during the elementary-school year and is a strikingly successful vehicle of learning." The writer adds: "However, manipulative experiences are equally beneficial." The classroom teacher will do well to ask herself what her purposes for employing an activity are and then decide whether a manipulative experience, if that is possible, will achieve this purpose better than any other activity,

for example, a dramatic one. Much that has been done in the elementary school in the name of activity, has achieved nothing but getting the children out of their seats. It is not uncommon to see dramatics used in science resulting both in poor dramatics and poorer science. It is hoped that the writer of this section of the Yearbook did not intend to dismiss manipulative experience as an "also ran" activity in science classes.

In discussing the selection of a science problem for consideration by a science class, the Committee states that selection of such a problem may be "the result of co-operative effort of the entire group, including the teacher. However, in some instances it is well for the teacher to choose the problem for investigation and present this problem to the group in such a manner that the children will be eager to work toward the solution." And a healthy suggestion this seems to be. The writer of this section of the Yearbook indicates that lack of background may make it impossible for children to propose many of the most interesting problems in science.

Frequently teachers labor under the illusion that the children themselves have selected a problem for study, when in reality it was proposed by one aggressive or interested individual in the group and then taken up by the others. At present when the teachers of elementary science themselves feel their lack of background it may be much better for them to plan in advance at least some, and probably many, of the problems to be considered and perhaps do so partly on the basis of their own backgrounds. After developing their own confidence they may be better able to follow leads of children and guide the study of a pupil-initiated problem.

The section on materials and methods extends a point of view important for special consideration when it states: "Experiments should be utilized for instruction rather than as a display of magic." Purposeful experimentation is certainly an essential part of every science program in the grade school, but meaningless manipulation is not. More and more teachers must learn to use apparatus as a means of making ideas clear, for solving problems, and not as an activity confined to use of apparatus for the sake of saying, "Oh, yes. We have experiments with all of our units." The section of experiments and other activities merits careful study by all readers interested in the science program.

Regarding the use of books, the Committee emphasizes that frequently children's books are not utilized as well as they should be and these we all know to be true words. It is emphasized that the teacher must constantly work *with* the child to insure that the basic book "can lead to dynamic motivation and vitality of instruction."

Probably the chapter with the most far reaching implications is that which deals with improvement in instruction. Much of the material developed in the other chapters—the objective indicated, the organization recommended and other aspects of the plan for teaching science in the elementary school, can never be fully realized until such time as the classroom teachers are better prepared to teach science. At present the machinery for effecting this preparation of teachers is not in operation. The institutions that train teachers to instruct in the elementary school are not at present offering sufficient courses of the proper content to fit the classroom teachers to assume adequately the responsibility for science teaching. The Committee recommends that: "There should be three six-semester-hour courses in subject matter and a special methods course in the teaching of elementary science." The committee also indicates, and, this is especially significant, that: "In the three subject-matter courses, the subject matter will be organized in large units which will develop the major generalizations within each area and which will, to a large degree, cut across artificial subject-matter barriers. The criteria for the selection of the subject matter will be: (1) Does

the subject matter contribute to the development of a well-educated individual? (2) Does the subject matter contribute to the preparation of a well-equipped elementary-school teacher?" Each of the three courses, the committee indicates, should provide for laboratory and field work. In the special methods course: "The student should be given opportunity to see how the materials of the preceding courses in science can be organized into teaching units for the grades in which he is preparing to teach." Furthermore the Committe urges that the student be given opportunity to become acquainted with text books and other literature written for children and to learn about sources of materials as well as to "observe a number of lessons brought by a superior classroom teacher and later discuss and evaluate the techniques observed." In addition to this pre-service training the Committee urges a "democratic and cooperative planning of in-service education" and sets up possible procedures for instigating it.

If those who are responsible for training and supervising teachers who must teach science well in the elementary school, can put into practice some of these suggestions for equipping our teachers, the plans set forth in this excellent section on elementary science in the 46th Yearbook may well become the reality the Committee visions. Without their help the progress will continue to be slow.

But the problem of teacher preparation, as we all know, is not a simple one. It is more than interesting to note, for example, that the Committee has suggested that approximately 20 semester hours out of the usual 120 hours required for graduation, be allocated to preparing the teacher to teach science. This is approximately one-sixth of the total time. General education, psychology, art, music, arithmetic, health, language arts, social studies, etc., also make demands in terms of semester hours. It is hoped that the Committee is ready not only to justify the use of this large block of time in relationship to the total available time, but able also to give concrete assistance to those responsible for planning the programs in the institutions that train teachers on how to stretch the total time and make it adequately fit all of these urgent needs and pressures.

DISCUSSION OF THE FORTY-SIXTH YEARBOOK NATIONAL SOCIETY FOR THE STUDY OF EDUCATION

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It is an educational opportunity to comment on the values and worthwhileness of the 1946 Yearbook of the National Society for the Study of Education. It is important for the development of group interest that the members inventory periodically their successes and failures. It is perhaps doubly important to project the thinking of the science group into the problems which lie ahead and to observe the social impact which science has made upon the people through the educational processes. The schools represent society's best tool for projecting most easily our culture into the future.

The Yearbook contains much valuable and worthwhile material. While it is one of our functions this evening to criticise, I feel we should do so only in a constructive manner and in justice to the Committee develop strong points together with suggestions for improvement. I am intrigued especially with the purposes set forth in the Yearbook to develop workable teaching units based on existing research and best practice. Generally speaking education has failed to make the best possible use of research. Expediency based on ignorance has been too frequently the controlling factor in classroom practice.

It is true that the Committee members are to be commended for their personal disregard for approval in leaving their names off the chapter headings. This practice appears to me, however, to be a mistake. We must of necessity judge materials in the light of the philosophy of the writer. It is impossible in written and spoken words to comprehend the finer shades of meaning without understanding the broad principles for which the writer stands.

I noticed a statement in the Yearbook that 4,000 copies will be published. Even though there are many more than this, we must admit that the number is far too small to reach very many teachers in the classroom. It is unfortunate that so much of our published material is available to a limited audience. Unless there is a concerted and planned program for the dissemination of the Yearbook material, it will have but little effect on the actual teaching of science in our schools.

The Committee is especially sound in its efforts to encourage reevaluating the materials of science teaching. As the Yearbook points out, there is a strong tendency to retain teaching materials long past the time when they represent the best experiences for use. The use of learning materials growing out of the experiences of members of the class offer an opportunity to make more dynamic classroom instruction.

The organization of the Yearbook into special treatment for the three school divisions makes for some boredom in reading. Frequently material applies obviously to all three divisions. For example, as the manuscript is read in its entirety, much repetition and enumeration of supplies and equipment used in auditory and visual aids are found.

Insufficient space is given in the Yearbook to the changing organization of our schools although some reference is made to the fact that the junior college represents one of our special problems of secondary education. If, as generally supposed, the junior college or the thirteenth and fourteenth grades become an integral part of the secondary school, the eleventh and twelfth grades will become more closely associated with the higher grades. There is a rapidly growing need for this type of organization to provide for the vocational needs of thousands of our youth.

Readers will find the Yearbook especially valuable for those wanting a quick review of the literature on science teaching. Special reference is made to the Commission on Reorganization of Secondary Education, 1920; The Place of Science and Education, 1927; and the Thirty-First Yearbook of the National Society, 1932. References to the relationship of science to general education have been developed, although too meagerly, by citing the implications of Education for All American Youth, 1945 and the General Education of a Free Society, Harvard Report, 1945.

The Yearbook points out some important considerations related to the teacher. There is a special appeal for the teacher to arouse student interest in science. The report urges the teaching of children rather than the teaching of books. The Yearbook observes that the greater competence of women in handling scientific materials will greatly aid science teaching in the classroom. An appeal is made for teachers to continue their professional training as long as the teacher is in the classroom. It should be pointed out that this emphasis on continual training calls for adequate teachers' salaries based on the twelve month teaching year. It does not call for stretching nine months pay over a twelve months' period but actually recognizes that the teacher would be employed on a twelve months' basis and subject to school board policies for the entire year except for reasonable vacation periods. This plan contemplates that during the long vacation period some teachers would work on curriculum materials, some would take designated travel trips, others would return to summer school for special classwork. If we are going to have teachers who are sufficiently well

trained to meet American educational demands, our school districts will have to re-evaluate their estimation of teachers as reflected in salary schedules. Good teachers should not be forced into administrative positions in order to secure respectable salaries. We must find the way whereby superior teaching may be appraised and paid for in salaries reaching to five and six thousand dollars a year.

The Yearbook points out that political thought and science have "differed widely" only because science has outrun common knowledge. The scientist has gone his way with his experiments and a few followers, almost ignoring public knowledge and information. On the other hand, quacks and pseudo-scientists have been loud in their claims, filling the ether and newspapers with their various preachings. The scientist can best remedy this situation by living and working with his less-trained fellows. Obviously much of this responsibility will fall upon the teacher. The teacher must be broadly and well-trained to do this task adequately. In this discussion this evening members of the panel who have preceded me have pointed out ably the necessity for broad training rather than the highly specialized scientific training recommended by the Yearbook for our teacher training programs.

All in all, the Yearbook represents a fine contribution to our professional literature. The collection of evaluation procedures as presented in the final chapter will greatly aid teachers in an understanding of student concepts. Each Committee member is to be congratulated for his contribution.

SCIENCE EDUCATION IN AMERICAN SCHOOLS: THE YEARBOOK AS VIEWED BY THE SCHOOL ADMINISTRATOR

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FIFTEEN years ago, I addressed the annual meeting of the National Society on this same subject. I welcomed this return engagement for the opportunity it gives to keep abreast of developments in science education.

In anticipation, I wondered what this Committee would attempt. Would it carry us to the mountain top to view the wonders of the atomic age? Would it be satisfied to focus our vision on the marvels of the air age? Would it dwell on the role of science in the war? Would it stress the contributions of science to the relief of men's suffering through medical and surgical care? Or would it be satisfied to give us but a glimpse of "the shore dimly seen" in the realm of science?

The latter course was chosen by the Committee, and rightly so, I think. It ventures no speculation on the atomic age, nor even on the air age. It makes respectful allusion to, but attempts no appraisal of the contribution of science to winning the war, nor to alleviating the suffering of humanity. The committee has held to its theme, *Science Education in American Schools.*

What has happened in the fifteen years since the National Society presented its Thirty First Yearbook, *The Teaching of Science?* What changes do we find in this yearbook that concern the administrator of public schools?

Comparing the two yearbooks, I find three fundamental changes. The first is the larger role of science in the elementary school. The second is the impact of general education on science education. And the third is the growing recognition of the responsibility of science and of scientists for the social effects of scientific discovery and invention.

The Thirty First Yearbook gave three chapters to Elementary School Science.

Reading it again one gains the impression that its spokesmen for elementary science were admitted to the inner circle of science teachers but with little conviction as to the worth of their contribution. The authors of those earlier chapters wrote as if they knew they were on trial. In some places the reader felt they were unsure of their ground, that they were straining the argument.

The Forty Sixth Yearbook gives a different impression. Six chapters are given to elementary science. The authors of these chapters present their report with confidence. Back of them is fifteen years of tested experience. Their argument is no longer strained. They confidently rest their case on under statement. But what is more important, the entire Committee recognizes that elementary science has come to stay; that its contribution in the elementary school is sending a new generation of youth to the study of science in the secondary school; that its emphasis on attitudes, interests and experience is changing the objectives, content and organization of science in the secondary school.

Admittedly, the secondary school is puzzled and a bit confused at this change. Reading the chapters on science in the secondary school, one gains the impression that the authors would like to forget the effects of this trend of science in elementary schools. But one gains, also, the impression that like the people in the story of the camel and the tent, having admitted the camel, they are now doing their best to adjust their lives to the new situation.

While the ultimate effect of six years of elementary science on science instruction in the secondary grades as yet can be only "dimly seen", it is certain that the emphasis on children's attitudes, interests and experience will lay an entirely different foundation on which the upper school can build. And it is also certain that the secondary school will need to reorient its entire program of science education to serve adequately the new generation.

The first awareness of the new problem confronting the secondary school is seen in the Committee's consideration of the growing trend toward general education. The Committee presents a fair analysis of such leading reports as that of the Educational Policies Commission and of the Harvard Committee on General Education. It concludes that these reports are in substantial agreement that,—

1. Science education should begin early.
2. All science education in elementary and secondary schools should promote general education.
3. The development of competence in the use of scientific methods of problem solving, and the inculcation of scientific attitudes transcend all other objectives in importance.

As will be noted later, the Committee does not wholly accept these conclusions as to general education. Neither does it recognize clearly that general education in the secondary school is the inevitable extension of the purposes and contributions of elementary science to the upper grades. Nor has the secondary school group quite realized that the job now is no longer to write high school and college science down to young children, but rather is to extend the proved principles of child development upward throughout the secondary school. These are considerations that the administrator will weigh carefully in placing the yearbook before his teachers and supervisors.

The Committee present clearly and consistently the need for public understanding of the social effects of scientific discovery and invention. The thesis is well stated in the chapter, *Science and People*. Throughout, the Committee emphasizes such concepts as,—

- the futility of keeping scientific knowledge secret,
- the importance of a knowledge of science in shaping legislation,
- the contribution of scientists to public affairs,

the growing respectability of health knowledge.

The Committee stresses that science knowledge should create awareness of the problems, influence behavior of individuals, and carry over into decisions of citizenship.

On the whole the Committee has reviewed thoroughly the experience and the research of the past fifteen years. In a chapter on *Issues in the Teaching of Science,* the Committee presents its conclusions on 26 issues currently debated. None of these issues are new. Where a substantial body of research is available, the Committee is usually sound in its conclusions. Where it must stand on its own judgment, the administrator will be less ready to accept its conclusions. Following are a few conclusions that interest the busy administrator:

1. The Committee advocates a twelve year sequence of science but admits that the issue is in a state of flux in the upper six years and may not be attainable in all schools.

2. The Committee advocates three years—not less than three periods a week—of general science in the junior high school, but would settle for two years—five periods a week. In the two-year program it would offer ½ unit of earth science, ½ unit of health and physiology, and one unit of general science. The main objective of all science instruction in these years would be general education.

3. In the senior high school, the Committee would require one year of general biology and at least one year of physical science. It would consider a general physical science course as a substitute for the specialized course in physics or chemistry.

4. The Committee notes the development of new courses such as consumer education, conservation, physiology, health and aeronautics; but with the possible exception of health as a separate course in the junior high school, would include all of these as units of work in the secondary school science sequence.

The administrator will accept these recommendations concerning health education with reservations. The emphasis on health during the past decade and especially during the war makes one question whether this particular Committe is competent to pass upon so important a problem. Certainly it presents no data to support so casual a disposition of so important an issue.

5. The outcomes of the research summarized support the Committee's conclusion that five one-hour periods a week are satisfactory for science, that laboratory and lecture are best combined in one room, and that teacher demonstration is more effective than pupils' repetition of experiments already proved. In the treatment of these issues the administrator will find material useful in planning buildings and programs and in supervising instruction.

6. The Committee is afraid of a core curriculum for it has not yet visualized how such a curriculum is developed. It regrets that science teachers have not been called in to help the teachers of English and social studies who seem to have taken the lead in such ventures. It submits the belief that science teachers should take the lead in developing such programs and that when units of work are developed the social studies teachers should be called in to advise on the social implications of the unit. All this is very naive; but administrators will welcome the fact that, at long last, science teachers recognize a problem—the need for cooperation with other specialists in curriculum building—and will see that the cooperation begins at the beginning not after one group or another has done the job.

7. The Committee still clings to the textbook as the chief tool of instruction and presents useful observations on the science work book.

8. It notes with approval the growing extension of the secondary school into the thirteenth and fourteenth years, and proposes a comprehensive science survey

course for these years. However, the course suggested sounds very much like some more of the same thing the student has had during the twelve years in elementary and high school. The administrator moving into these two crucial years will seek a more fundamental treatment of science for the 13th and 14th years.

The Committee is opposed to all evaluation by authorities outside the teacher, e.g. College Entrance Board, Regents, or statewide testing programs. It gives two chapters to evaluation—one in the elementary school, the other in the secondary school. Both chapters are good and will be useful regardless of whether agencies outside the teaching staff contribute to final evaluations.

In setting standards for the education of science teachers, the committee most clearly displays the breadth and the limitation of its thinking. Its proposals are summarized as follows:

A. For all prospective teachers of science in secondary grades:
   1. Survey or integrated course in biological science (drawing from anatomy, bacteriology, botany, ecology, entomology, health, physiology, and zoology, and possibly others, including lectures, laboratory, field work) 9 to 12 semester hours
   2. Survey or integrated course in physical science (drawing from astronomy, chemistry, geology, meteorology, and physics, and possibly others, and including lectures, laboratory and field trips or excursions) 9 to 12 semester hours
   3. Survey or integrated course in social science (drawing from anthropology, the development of civilization, American history with emphasis on economic, geographic, and sociological factors, and the development of political and social institutions and problems—lectures, laboratory, and field work using the community as a laboratory 9 to 12 semester hours
   4. Algebra, plane geometry, and trigonometry 2 high-schol units or 9 semester hours

B. In addition to the above, prospective teachers of general science in junior high school grades would take:
   1. Courses in botany, human physiology, and/or zoology 9 to 12 semester hours
   2. Courses in chemistry and/or physics 9 to 12 semester hours
   3. Courses in astronomy, geology, meteorology, and/or physical geography 9 to 12 semester hours

C. Prospective teachers of science in senior high school grades would take, in addition to the survey courses 1, 2, and 3, the following:
   1. Additional work in (a) biological sciences (including both botany and zoology, or (b) chemistry, or (c) physics to obtain a total in one area including the corresponding survey course of at least 24 semester hours
   2. Additional work in the two areas not chosen in (1) to obtain with the other science survey an average of 18 semester hours in each or a total of 36 semester hours.

Standing alone, this outline appears sound and plausible; but where does it leave the Committee's emphasis on child development; on attitudes, emotions, interests; on social effects of science instruction; on cooperative effort among all teachers in curriculum development; on the contribution of science to general education? Here is the specialist—naked and unashamed. Here is the specialist giving lip service to general education, to child development, to the attitudes, interests and experiences of children, but still maintaining that knowledge of his subject is the *sine qua non* to the attainment of all that is good.

As an administrator I do not want the kind of teacher the college will produce through the curriculum the Committee recommends. The junior high school teacher with 45–60 hours of college science on top of a twelve-year sequence will place his subject above children. He will lack that broad understanding of the worth of other knowledge. He will not know how to cooperate with other teachers in developing a balanced curriculum. He will continue to give lip service to the objectives of general education without understanding its meaning. In some degree the same criticism holds for the high school teacher whom the Committee would require to come out of college with not less than 60 hours of science education.

In its recommendations for teacher education the Committee has strictly joined the issue between general education and specialized education in the secondary school. The youth of this country will be better served by extending upward at least through the junior high school, the principles so ably presented by the Committee for the elementary school.

Running throughout the yearbook and ably summarized by Dr. Caldwell in the concluding chapter are the committee's thoughts on the social consequences of scientific discovery and invention and the problem it presents to the schools. "There can be no stopping of scientific research in order that society may catch up." "What science may *do for men* must become subordinate to what science may *do to men.*" "Scientists . . . are forced by current events to broaden the areas of their thinking." Such are some of the concepts running through this yearbook which administrators will want to make the heritage of every child in our schools.

SCIENCE EDUCATION IN AMERICAN SCHOOLS

Discussion of the Forty-Sixth Yearbook of the National Society for the Study of Education

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This *Forty-sixth Yearbook* of the Society is the third in the series to deal with science and science teaching. It is important to note the continuity in these reports. The *Third Yearbook,* Part II, (1904), written by W. S. Jackman, was the first on teaching science. The Committee of the *Thirty-first Yearbook,* Part I, (1932), recognized the validity in Jackman's recommendations and in some particulars refined and extended them to conform with conditions existing three decades later. Similarly, the present committee has recognized the basic nature of recommendations made in the *Thirty-first Yearbook.* The reader will recognize at once, in the discussions of objectives, the continuity from one report to the next. Some critics undoubtedly will think that the present Committee has been too generous in its endorsement of the earlier reports and some members of the Committee of 1932 may raise more questions about the current applicability of certain recommendations than are raised by the reporting Committee. This is not to say that the present report merely repeats its predecessors, but rather that in a number of instances it has recognized the earlier report, and, taking account of the accumulated experience of fifteen years, has gone on from where that report left off to incorporate many shifts in emphasis and much new material.

Under Purposes of the Yearbook the first

statement is: "To make the report as practicable as possible." (page 2). The discussion implies, with some propriety, that other recent reports lack practicability in that the point of view of classroom teachers has been neglected. In this attempt to be practical, the Committee has met with considerable success. The sections on science for the elementary school, physical science for the senior high school, special problems at the secondary level, and evaluation, seem to merit special recognition, for teachers will find in them recommendations and suggestions directly useful in that they offer practical answers to immediate and pertinent questions.

A second purpose is "To review and appraise available research in science teaching and to suggest desirable types of problems for further study." No section has been set apart in the book for a review of research, but research data and conclusions are introduced wherever they seem pertinent to the discussion. It is reported that the number of research studies in the interval since 1930 has been fewer than during the two decades preceding 1930, but in the opinion of the Committee: "the average quality of investigation has improved." (page 2). This rating of research is given without supporting evidence.

Another stated purpose is to examine and appraise new developments and new courses, methods and devices in the light of implications for the future. This is "regarded as one of the important obligations of the Yearbook Committee." (page 3). Trends in developing objectives, materials and methods of science teaching appropriate for each of the divisions of the school are presented under proper headings. There are discussions of laboratory teaching, field work, auditory and visual aids, and other methods and materials commonly used by science teachers. In the discussion of science in the elementary school it is pointed out that elementary education has developed as a whole undertaking, and that science is to be taught as a part of a total coordinated effort. In the main, the report on science in the elementary school is more nearly consistent with this commitment than is the section of science in the high school.

This Committee has largely avoided discussions of trends toward closer coordination of secondary education agencies, and suggestions on how science teachers may work more effectively as a part of a total integrated effort. No reference is made to the widely circulated bulletin *Planning for American Youth,* by the High Schools Principal's Association of the National Education Association. The recent report of the John Dewey Society, *The American High School,* gets no recognition. Only brief reference (pages 20 and 191) are made to the report of the Educational Policies Commission of the National Education Association, *Education for All American Youth,* and it is said that "most science teachers will probably not be satisfied with the kind of courses which are recommended." Science teachers are, however, advised to study this report "with care and with an open mind." There are two references (pages 20 and 191) to the report of the Harvard Committee on General Education, and the implication is clear that the Committe thinks science teachers will like this report better than they will like the one by the Policies Commission. *The New York Regent Plans for Post-War Education,* with its very challenging scheme for education that will be continuous into the real activities of the work-a-day world and not merely into college receives no mention. These omissions seem most unfortunate inasmuch as the reports mentioned have been prepared by recognized leaders in education and that they emphasize the need for, and suggest ways to achieve cooperation among competent teachers in the education of youth. Illustrations of successful cooperation among high school teachers, working with recognition of the total program of youth education undoubtedly would have served a very useful purpose for

readers who are to be teachers during the next ten years.

In a Chapter on "Issues in the Teaching of Science," the Committee takes the position that the important issues of today have been with us for a long time: ". . . few are new." (page 41). The issues reviewed deal with content, method and organization of science in each of the administrative divisions of the school. Special mention is made of physical sciences for the senior high school, and such items as consumer education, conservation, aeronautics, the core curriculum, textbooks, audio-visual materials and laboratory work.

The issue of survey courses is resolved in the recommendation that the science of the senior high school should consist of integrated courses such as general biological and physical sciences, "along with or in place of" the specialized courses such as physics or chemistry; all courses to provide "general and propaedeutic" education. Similarly, on the junior college level, the offering in science should consist of survey courses in both the physical and biological sciences.

The content of physical science in the senior high school is to be drawn from geology, astronomy and meteorology, as well as from physics and chemistry. The position taken is that practical considerations "dictate that the course should be planned for one year and not for two." (page 45). It is recommended further that if the course is "to realize its full potentialities it must serve both as a 'college preparatory' and as a terminal course." The practice of offering special courses such as aeronautics is not approved.

The Committee "approves all opportunities" to experiment with new ideas, and mentions the core curriculum as "providing salutary opportunities." (page 47). It is pointed out, however, that in current practice "the teachers having major responsibility in planning core units are not fitted by training, experience and general outlook to recognize the opportunities certain to arise in any 'real life' unit for introducing important materials from the fields of biological and physical sciences." It is insisted that "science can be taught effectively only by teachers adequately trained, and by means of units of work whose primary emphasis is scientific," and that the "major emphasis would be directed toward employing the elements of scientific method inculcating scientific attitudes and arriving at functional understandings of scientific concepts and principles." After the Committee has, in the next paragraph, given strong endorsement of the practice of using a "basic textbook as the general outline of the course" (page 48), the spirit and method of the core curriculum approach seems to be largely denied.

Films are to be used for orientation, for supplementary materials, for clarifying concepts, and for summarizing topics and units. The teacher is advised to study a film before using it in a class, and to provide "guide questions for its study, and a test to be used as a follow-up of presentation." (page 50). Some questions are raised with regard to the relative merits of silent films, sound films, and film strips. It is stated that the unique value of film strips renders them superior to motion pictures for some purposes. No references is made to the use of lantern slides.

It is stated that the primary purpose of experimenting in the laboratory is "to secure evidence which may reveal answers to problems." The pupil should be encouraged to record exactly what he observes, and he should not be penalized for errors resulting from the limitations of available apparatus or his own manipulatory skills. After having arrived at the best answer to the problem upon which he is at work, it is then "proper" for him to consult the textbooks and references to find out the correct results. Such practice, it is stated, "is ideal for the teaching of scientific method and for developing scientific attitudes." (p. 52).

The demonstration method is approved

largely on the basis of economy in time and materials. Demonstrations should in general be presented by the teacher and not by the pupils. It is recommended that a student keep a record of every experiment performed, including diagrams and sketches. The record should be written in the laboratory while the experimentation is in progress, and while conditions are favorable for the teacher to lend assistance.

In general it is suggested that science courses be "conducted in a room which is combination laboratory and classroom." The trend toward eliminating the double laboratory periods in senior high school is defended as "in most respects desirable." (p. 44).

The Committee's chapter on "Issues" probably will be quoted extensively in some quarters. It seems important to say that on several points other educators will disagree with some of the positions that are taken. Certainly many will think that important new issues have been raised about science teaching since the 1930's. Some will question whether or not present courses in science are well planned for meeting the needs of youth, and will ask why so many youths in high school and in college look upon courses in science as uninteresting and to be avoided. The implications of this question have been forced upon educators at a time when high school enrollment has been increasing. Many will take the position that present-day practices in laboratory teaching with preparation of laboratory notes is largely or entirely outmoded, and that the usual laboratories in school buildings of today are not at all well suited for educating youth in the methods of using science in their lives. Some will take the extreme position that present promotional examinations are hindrances rather than aids to real education, and will maintain that the immediate needs of youth should play a larger part in determining what young people should learn. The Eight-Year Study of the Progressive Education Association and recent policy reports from influential organizations have brought these matters sharply to attention, but they have been largely neglected in the current report.

In its chapters on "Objectives" the Committee provides "a working philosophy to pervade and unify the entire report." (page 25). They incorporate a social viewpoint for science teaching, and give acknowledgment to the *Thirty-First Yearbook* of the Society and the report *Science in General Education* of the Progressive Education Association. The objectives are grouped under (1) information or facts, (2) concepts, (3) principles, (4) skills, (5) attitudes, (6) appreciations, and (7) interests. The discussion of facts, concepts, and principles is noticeably similar to the discussion in the *Thirty-First Yearbook*. Under instrumental skills there is special mention of reading and the fundamental operations of arithmetic. "Problem solving skills are those employed in reflective thinking." "Scientific attitudes are held to be concomitants of scientific methods." (page 34). The relation of the Committee's objectives to general education is illustrated through a discussion of conservation. This chapter is presented as "a social philosophy and a set of practical objectives for science instruction."

In its chapter on "Trends and Objectives in Secondary School Science" the Committee extends its analysis of objectives, and offers suggestion on the applicability of these objectives in the grades beyond the elementary school. The skills analyzed include those involved in locating and using source material, solving mathematical problems, making observations, and using elements of the scientific method.

The reader will meet with some difficulties as he reads through this discussion of objectives, though much of it is useful. Under the discussion of instrumental skills it is stated that "science is quantitative and exact or it is not science." (page 32). In or out of context the statement seems too positive. One must ask how quantitative

and how exact must thinking be in order to be scientific. Are we thinking quantitatively when we say this distance, or this mass, or this intensity of light is more than another distance, mass or light intensity? Are we exact? Such thinking is certainly exact enough for many common purposes. In taking this extreme position the Committee may be, in the minds of its readers, setting science apart from ordinary day to day experiences.

In its discussion of the use of scientific method in problem solving (page 144), and growth in the development of scientific attitudes (page 147), the Committee presents such an array of principles that the usefulness of the statement seems lost. The analysis of scientific thinking includes these main points selected from a list of eight: sensing significant problems, studying the situation for all facts and clues bearing upon the problem, selecting most likely hypotheses, testing a hypothesis by experimental or by other means, and drawing conclusions. Each of the eight statements is further analyzed. The criticism of these statements about methods and attitudes is that they are not descriptive of methods or qualities recognizable as useful by boys and girls or by men and women in ordinary walks of life. An analysis of scientific method will be meaningful and helpful to learners and teachers only when presented with illustrations identifiable as applicable in the lives of young people. The Committee points out (page 103) that a good deal has been written about scientific method and that teachers generally give approval of its importance but seldom teach it. This observation may be explained on the assumption that, as commonly described, scientific method and scientific attitudes are not recognized by practical teachers and people outside the school as being useful in the kind of thinking they do in the practical work of day to day.

In this report an unfortunate figure of speech is used, in which science is personified. The practice of using this figure is not uncommon, particularly in popular writing and in lectures, and it undoubtedly has encouraged the creation of a number of unfortunate cliches and has given to the word *science* the flavor of dogmatism. It is stated that "science contributes to social standards", p. 10), "science is making important discoveries" (page 13), "science has opportunities" (page 17), "science and social studies work toward similar objectives" (page 35). Some of the statements credited to "science" seem strange indeed. "Science cares only for indisputable evidence, . . . science suspends judgment, . . . science recognizes that no knowledge is everlasting . . ." (quoted from page 171). It must be pointed out that science is not a person but may be described as a body of organized knowledge or as a method of work and study.

It is through scientific work that men have gained verifiable ideas about the world and man. These ideas are incorporated in the thought pattern of individuals and groups, and in the cultural heritage. They are, in turn, affecting the thoughts and actions of artists, theologians, philanthropists, and people generally. It may be feared that the practice of personifying science encourages a tendency to think of science as something whose inherent nature sets limits upon the freedom of men to use their minds. The so-called conflicts between science and religion, and between science and art, are conflicts between dogmas; that is, conflicts between the conclusions of individuals who often are self-constituted authorities. Personification of science fosters such dogmatism, and is to be deplored.

In the list of objectives is included: "appreciation of basic cause-and-effect relationships" (page 29). In another place (page 215): "belief in cause and effect" is referred to as a scientific attitude. It seems appropriate to question the usefulness of these references. Scientists of today generally agree that the assumption of cause is not helpful in scientific work, and at least some authorities maintain that there are no

causal laws in the physical world. The concept of cause is a heritage from the past, and in current usage it implies nothing more than recognition of meaningful relationships among phenomena.

The strength of this report is in its practical suggestions for teaching science in the different divisions in the school system. The section on "Science in the Elementary School" represents a cooperative effort of 16 people and the report on the work of the junior and senior high school level the work of 17. Most of these contributors were classroom teachers and their reports reflect the superior quality of their instruction.

The section on "Science in the Elementary School" recognizes the wholeness of elementary education, and urges that science not be "developed in the elementary school for its own vested interests but rather for its contribution to the needs of children and to the welfare of society." (p. 60). Neither individualized instruction nor "graded groups" are recognized as essential on the elementary level. Furthermore, it is assumed that a "rigidly planned science program which sets up specific content and achievement goals cannot provide adequately for the varying needs of children in different communities." (p. 70). Summarizing the point of view on organization of the curriculum in science, it is said that the new program in science emphasizing "the development of desirable social behavior is organized around problems that have social value and are challenging and worthwhile to children." (p. 92). The spirit of the discussion of needs is in part conveyed by stating that "children do not discover new facts for mankind; but they do discover new facts for themselves and they must do that day by day if they are to become fully equipped for the age in which they live." (p. 92). The chapter on "Resource Material" is divided into suggestions for work in rural and in urban environments. Exploring the environment provides opportunities for "children's discovery of themselves as an integral part of the work about them." (p. 97). In work with young children evaluation is assumed to be an integral part of learning; it requires that goals be recognized but not necessarily that standards be set. It is suggested that a most important application of the data from evaluation is in the planning of new instructional material. There is evidence that in general the several contributors to the section on "Science in the Elementary School" were in good agreement among themselves on the recommendations that they offer.

In the discussion on "Science in the Secondary School" it is recognized that "the general trend in science courses throughout the junior high school, the senior high school, and junior college has been toward generalized courses planned to meet the more immediate science needs of the common users of science." (p. 139). In its chapter on "Trends" a compromising position seems to have been taken when it is stated that the "problems associated with the education of young people for effective living are highly complex" and that "it is practically impossible to set up classroom situations which actually duplicate situations and problems encountered outside of the school." (p. 140). It is suggested, however, that the science teacher will "seek out the social implications of his material of instruction" (p. 144) and the importance of planning "suited to the needs of young people of varying maturity" is recognized. (p. 157).

In the discussion of high school methods no enthusiasm is shown for the use of films. It is admitted that "films well selected have educational worth" (p. 162) but that "available investigations do not support the current enthusiasm for sound motion pictures in teaching science." The Morrison Unit Plan is approved as superior to "conventional procedures." Advocates of the core curriculum will hardly agree with the implications of the Committee's statement: "If the curriculum of the school of

the future is to be organized on the pattern of present experimental cores, scientific facts, principles, interpretations, understandings and attitudes will need to be incorporated in the unit." (p. 166). The methods in problem solving outlined for general science probably will not find large application in a core curriculum.

The Chapter on "Content and Methods of Senior High School Science" includes suggestions on biology, general science, physical science, chemistry and physics. Under the discussion of biology, it is stated that "the trend has been toward focusing attention less on the organization of subject matter and more on the results in the lives of the learners." (p. 184). The scope of the course in biology is given in major headings, and it is suggested that the course should be planned "with the children instead of merely for them." The discussion with illustrations under physical science seems genuinely useful, (beginning page 190). The questions raised here are timely, and this treatment probably will exert wide influence in establishing the general nature of this relatively new course. Under chemistry, it is conservatively suggested that the "systematic development" be retained, but that the course be enriched by the study of "methods of science and with concepts that relate to real life situations." (p. 203). The suggestion that physics be organized about energy as a central theme is endorsed, with the recommendation that content be selected with reference to students interests and be of immediate value. It is further recommended that the course be organized "largely or entirely about problems, that students should have a share in planning, and that the preparatory function of the course should be largely rejected." (p. 211).

The chapter on "Special Problems on the Secondary Level" includes a section on recognition and encouragement of superior students. Reference is made to the Science Talent Search operated by Science Clubs of America. Only brief attention is given to the section in the Bush Report (*Science—The New Frontier*, Government Printing Office) in which this matter is discussed at length. There are practical recommendations on the use of radio, science clubs, community resources, the role of laboratory and demonstration teaching, sensory aids, planning the science room, purchasing equipment, and some other matters. The treatment makes this a ready and valuable reference.

Readers will find the chapter on "Evaluation" particularly useful. This chapter probably will be more widely read than any other chapter in the text, not because it is the best, but because it is good and timely.

In its recommendations on the "Education of Teachers" the Committee recognizes earlier reports, re-interpreting them in the light of criticisms and changed conditions. The recommended plan of courses will require approximately 50 per cent of the prospective teacher's time during his undergraduate study. This suggests the conclusion that if the Committee's recommendations are valid, it will be necessary to extend the period of training to five years.

The report is an important contribution to educational literature as is evidenced by the fact that it has brought important issues sharply to attention. Its greatest strength is in the achievement of the Committee's first objective; namely, to prepare a report that will carry practical suggestions for teachers of science. In the main, the Committee seems to have assumed that science content, organization, and method will continue to be much as they have been in the past, with increasing tendency toward general courses, and with content selected and organized with references to its social implications. While recognizing the merits of this report and congratulating the Committee on its success, it has seemed appropriate to point out that there is a considerable gap between the recommendations of this Committee and the recommendations of other groups now exerting strong educational

leadership. It is only in the recommendation for science in the elementary school that one finds sympathetic recognition of this other leadership. As matters stand, science teachers are inadequately informed about general trends in education, and the curriculum worker is generally uninformed about the recommendations advanced by teachers of science. This Committee would have done a further service to education if it had dealt more in detail with the issues about which differences exist and had pointed more clearly to ways by means of which science teachers and others might cooperate effectively in the total program of educating youth.

A PRACTICAL EXAMINATION OF SKILLS AND TECHNIQUES ACQUIRED IN FRESHMAN CHEMISTRY

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LABORATORY work has long been considered a necessary and desirable part of a course in Chemistry. Among several outcomes of this phase of teaching, there are two which will be considered here. They are: (1) To acquire a better knowledge and understanding of chemical facts and principles, and (2) To acquire certain skills and techniques used in the laboratory.

Evaluation of laboratory work has always been difficult. The use of only the reports turned in by students at the end of a laboratory session has not proven successful, since it is often possible to produce a satisfactory report without an adequate understanding of the work done or the results obtained. In many cases the report can be made without performing the experiment at all. Difficulties of this sort may be reduced to a minimum through the use of experiments and reports which require the student to interpret and apply that which has been observed. In most cases, however, measurement of the attainment of the first listed objective can and often will be detected in the regularly scheduled verbal examinations. The laboratory report, though of some value in evaluating the first objective, does not give an adequate measurement of the attainment of the second objective.

Most teachers in laboratory sections now try to use observations of the students behavior under laboratory working conditions to evaluate his knowledge of, and ability to use, the proper skills and techniques. Such observations are often found inadequate since observations are not usually sufficiently systematic. All students cannot be observed using a particular technique at the same time; hence, there is little chance for direct comparison. A period of observation is often interrupted when the instructor is needed to straighten out individual difficulties which arise, or is giving additional help to the slower students, so the faster students get little or no attention. In addition, it is the exceptional teacher who makes a record of his observations and an evaluation of them for grading purposes while they are still fresh on his mind.

Although the attainment of the second objective may be measured through the use of verbal tests with some degree of reliability and validity, the employment of "practical" or "in the lab" tests has always seemed to be more desirable.

The use of examinations in which the student is required to assemble a piece of apparatus and perform an experiment has not proved too satisfactory since both the techniques and the subject matter of the experiment contribute to the final outcome. Again close observation is essential and hard to get.

At Oklahoma A. and M. College a practical examination was developed by the author for a freshman chemistry course for Home Economics students. A measurement of the knowledge of laboratory skills and techniques was attempted through requiring the student to recognize whether a technique had been properly carried out. The student was, for example, required to criticize a bend in glass tubing which was provided for inspection as a substitute for actually making a bend. In other instances the student actually performed the task such as reading the volume of a buret or the mass indicated by a beam balance. It was assumed that recognition of a faulty technique was closely correlated with the use of proper techniques.

Several days prior to the examination each student was given a sheet of general directions and was assigned to a station which she took upon entering the laboratory. The stations were locations at the regular laboratory tables. At the station was found the apparatus used in the test situation, a typed card stating the situation and asking a question, and the answer sheet which included the same questions and space for the answers. The answer sheet remained face down over the card until the examination started but was carried with the student from then on through the entire period.

After an introductory statement and a brief description of the path to be followed in the movement to successive stations, a starting signal was given. During one and one half minute intervals each situation was examined and the question answered. The time period was sufficiently long for the student to make her decision and write the answer but did not allow time for looking about to see what others were doing. In a regular 50 minute class period it was possible, using two sets of apparatus in a medium sized laboratory, to administer the examination to forty students.

This examination was not difficult to administer. Only two teachers were present during the examination period to serve the functions of timer, guide, and proctor. The construction and arrangement of materials to be used at the ten stations required two or three hours time of each of the teachers.

The questions naturally arise "How does this procedure differ from a 'pencil and paper' examination? Could not the same things be measured by such a test?" An examination in which students indicated which statements described good skills or techniques and which described poor skills or techniques was available for comparison. A comparison of the results of the practical and "pencil and paper" tests was made wherever items were found which tested the same material. In the compilation of the results which follows, only those test situations for which comparisons could be made were included. The description of these situations will give an adequate description of the test as a whole. Along with the description of the test situation from the practical examination is the written statement from the other test.

The questions are grouped according to the general divisions of the laboratory skills it was found expedient to use in building the examinations: construction and use of apparatus, laboratory measurements, adjustment and use of gas burners, and laboratory "housekeeping."

In the above table the following notation was used. Roman "I" refers to the division of laboratory skill; "A", "B", etc. refer to the practical examination test situations; and number "1", "2", etc. refer to the verbal examination questions as found in Table I. Columns 1 and 2 give the number and percentage of correct responses to the practical examination situations made by students in the lower quarter (based on the final course grade). Columns 3 and 4 give the same information about the corresponding statements from the verbal examination.

Columns 5, 6, 7, 8 present the same information for the upper quartile while Columns 9, 10, 11, 12 summarize the

TABLE 1

TEST SITUATIONS

Practical Examination	*Verbal Examination*
I. Construction and Use of Apparatus.	
A. Situation: A squeezed bent glass tube not fire polished inserted into a stopper but not projecting through. Question: A student was not allowed to use this tube and stopper in a gas generator. Why?	1. Make a smooth right angle bend in glass tubing. 2. Smooth the ends of glass tubing by fire polishing before use.
II. Measurements.	
B. Situation: A buret containing a liquid down below the general eye level reading 10.2 ml. Question: What is the volume of liquid used from this buret assuming that it was originally filled to the zero mark?	3. In reading a buret or graduated cylinder keep the eye at the same level as that of the liquid.
C. Situation: A triple beam balance is balanced with a salt placed directly on the pan. Question: The material on this scale is balanced. Indicate the total weight and what is wrong with the set-up.	4. In weighing chemicals, clean the pan and place chemicals on the cleaned surface.
III. Adjustment and Use of Gas Burners.	
D. Situation: The flame of a Bunsen burner heating a beaker of boiling water had a distinct yellow tip and no light blue cone at the base. Question: What change would you make to conform to the best laboratory practice in the use of a Bunsen burner?	5. Use the tip of a luminous flame for general heating.
E. Situation: A Bunsen burner properly adjusted but with wing top in place being used to heat a crucible. Question: If you wish to heat this material quickly and to as high a temperature as possible, what change would you make?	6. Use a wing top on the burner when bending glass tubing only.
IV. Laboratory "Housekeeping"	
F. Situation: The desk top unwashed, matches and broken glass in the sink, acid bottle on desk, stopper out and on desk. Question: A student left exactly as the bell rang. Why was her grade for the day lowered?	7. Wash your desk on completion of the experiment. 8. Put all used solids in the waste jars. 9. Carry the stock bottle to your desk in order to secure needed material. 10. Hold stoppers from reagent bottles in fingers when pouring the reagent.

TABLE II

NUMBER AND PERCENT OF CORRECT RESPONSES

QUESTION	LOWER QUARTER				UPPER QUARTER				TOTALS			
	Practical		*Written*		*Practical*		*Written*		*Practical*		*Written*	
	1 *No.*	*2* *%*	*3* *No.*	*4* *%*	*5* *No.*	*6* *%*	*7* *No.*	*8* *%*	*9* *No.*	*10* *%*	*11* *No.*	*12* *%*
I.												
A. 1. Bends	5	33.3	14	93.4	6	40	15	100	14	22.8	59	96.6
2. Fire Polish	3	20	14	93.4	6	40	15	100	14	22.8	59	96.6
II.												
B. 3. Buret Reading	4	26.6	15	100	9	60	15	100	26	42.5	55	90.1
C. 4. Use of Balance	0	0	10	66.6	4	26.6	15	100	7	11.4	47	78.6
III.												
D. 5. Burner Adjustment	8	53.2	3	20	7	46.6	6	40	31	50.6	47	78.6
E. 6. Use of Wing Top	9	60	11	93.4	13	86.5	13	86.5	41	67	52	85.2
IV.												
F. 7. Wash Desk	5	33.3	15	100	11	73.2	15	100	42	68.5	58	95
8. Clean Sink	2	23.3	14	93.4	2	23.3	15	100	4	6.5	58	95
9. Stock Bottles	10	66.6	14	93.4	10	66.6	14	93.4	47	77	59	96.6
10. Holding Stoppers	13	86.5	12	80	15	100	13	86.5	56	90	52	85.2

information for the upper quarter while two middle quarters.

A comparison of Columns 2 and 4, 6 and 8, and 10 and 12 shows that, in general, the verbal examination produced a greater percentage of correct responses than did the corresponding questions from the practical examination, whether the upper or lower quarters or the total number of students is considered.

When the practical test is considered, it will be seen by comparing columns 2 and 6 that the percentage of correct answers for the students in the upper quarter was greater than the percentage for the lower quarter. Comparison of columns 4 and 8 do not show as great differences in percentage of correct answers for the written test as do columns 2 and 6 for the practical.

Three situations in the practical examination seem to show little discriminatory value since the percentage of correct answers for the upper quarter of students is equal to or less than that for the lower quarter. These situations involve the adjustment of the Bunsen burner, the cleaning of the sink, and the disposition of the stock bottles from the reagent shelves. Questions covering the same situations found in the verbal test also show very little power to discriminate between students in the upper and lower quarters.

CONCLUSIONS

The higher percentages of correct responses on the written examination seems to indicate that this type of question overestimates the student's knowledge of what constitutes good or poor laboratory practice. However, it seems reasonable to suspect that higher percentage of correct responses for questions from the practical examination might have been found, had each test situation required that the student recognize only one factor instead of as many as the four factors which might have been found in some of the testing situations.

The results of the examination seem to indicate that students who recognize that a practice is poor in a verbal examination do not necessarily notice such wrong practices when they are encountered in their natural surroundings.

While the practical examination seems to have somewhat greater powers of discrimination than the verbal examination, not all of the testing situations and questions used have this power to the same extent. Some seem to lack discriminating power completely.

A practical examination of this type seems to have some potentially desirable features and qualities which might be developed through further use and variation

in design because the student is: (1) confronted with situations more nearly approximating actual working conditions; (2) the student is required to make an actual observation; (3) the student's chances of guessing the correct answer are reduced since more possible answers must be considered in making a choice; and, (4) practical examination situations and questions seem to have greater discriminating power.

A check of the validity of the type of questions in this examination should be worked out to determine if the original premise can be acepted, namely that the recognition of good techniques by the student has positive correlation with the use of such desirable techniques in the laboratory.

USING THE FILM *MAGIC BULLETS* AS AN EDUCATIONAL AID

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THE sixteen millimeter sound film *Magic Bullets* is now being distributed for the cost of transportation by the United States Federal Health Service, Publication-Motion Pictures-Radio Section, Bethesda Station, Washington, D. C. *Magic Bullets,* adapted from the Warner Brothers' film *Dr. Ehrlich's Magic Bullet,* is historically true, well directed and acted, and exceptionally suited for high school and college use.

At the point at which the film begins, Dr. Ehrlich has been carrying on pure research to find an arsenic compound which would kill a spiral-shaped bacterium causing a disease of mice. After announcement of Schaudinn discovery that the cause of syphilis is a spiral-shaped bacterium, spirocheta pallida (trepoma pallida), Dr. Ehrlich directed his experimental work toward this spirochete. He searched for a compound which, while being 100 per cent effective against the bacteria, would have a negative effect on the cells of the body, and likened the object of his search to a key which would fit the protein molecule of the spirochete but not the protein molecule of the animal cell. After long effort, after 605 failures, this search produced a medicine which was demanded by physicians all over the world as a tool (later improved) with which to wage war against syphilis.

Before the film is shown, students should know that third-stage syphilis occurs in many forms, involving practically all the organs of the body, crippling physically and mentally. They should realize that the search for a cure for syphilis required, and the application of the cure to stamp out the disease requires, a frank facing of the facts regarding the disease, rather than an attitude of silence.

Discussion following the film can be focussed upon these points, but students will want to bring out more. They may point out the dependence of scientific research upon generous financial support. They can gain an appreciation of the generosity of individuals and foundations in making gifts to scientific laboratories, as well as of the importance of participating in such support by buying National Tuberculosis Association Christmas seals and by contributing to the March of Dimes for the Infantile Paralysis Fund. Students may also recognize that prejudice based upon national or other differences has no place in scientific research. They may gain a respect for the accurate methods of scientific procedure, for the patience required, for the lack of desire for personal

gain. They will see that application of the findings of research is not the thing uppermost in the mind of the scientist. A very interesting comparison to make in this regard is with the recent abstruse, complicated research on fractions of animal blood made by Dr. Cohn at Harvard Medical School (described in the 1943 Annual Report of The Rockefeller Foundation), a study whose value has been demonstrated in thousands of cases wherever blood plasma has been shipped to battle areas.[1]

The film offers more than information about medical science. Students cannot see it without being impressed with the part which that person plays who stands by with encouragement and faith, as did Dr. Ehrlich's wife. For a time the observers live in an atmosphere devoid of prejudice, in a group where ability is appreciated regardless of racial origin. They are impressed that Dr. Ehrlich dared to think that his chemical would work; as one student expressed it, " He had great belief in his own ideas." The final words of Dr. Ehrlich on his death-bed are a challenge to youth, " We must attack greed, hatred, ignorance."

Biographical material from Eckstein's *Noguchi* relates vividly to the study of the spirochete. [2]

REFERENCES

1. *Science News-Letter*, April 17, 1943; May 6, 1944; September 9, 1944.
2. Eckstein, Gustave. *Noguchi*. Harper Brothers, New York, 1931.

RELATION OF MID-SEMESTER MARKS TO FINAL MARKS

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This study was made to determine the relation of mid-semester marks to final marks in a college physical science survey course at Oklahoma Agricultural and Mechanical College. Two major aspects of the problem were studied. Probably every teacher who has assigned mid-semester marks has sometimes wondered what the effect of assigning this mark or that mark will have upon the future achievement of the student concerned. There are several schools of thought relative to the kind of marks that students should be assigned at mid-semester.

One group, possibly the predominant group (at least in college teaching), believes that students should be assigned fairly low marks at mid-semester. They are motivated by the philosophical beliefs that it "looks bad" for a teacher to assign a lower mark at the end of the course than at mid-semester, and also because they are firmly convinced that lower marks act as a "study incentive" for the student. Hence at mid-semester they assign an unusually large percentage of F's and D's and few or no A's and B's. They believe a high mark acts often as an incentive to "loaf."

A second school of thought believes that the mid-semester mark should as nearly as possible represent the student's actual achievement in the course up to that particular time. Rather than to deliberately lower the student's mid-semester mark, they would be inclined to give him the benefit of the doubt. This group believes that a student is more likely to be stimulated to do better work by receiving his true grade at mid-semester, or in doubtful cases, even given the benefit of the doubt. Students, as well as people in general, react to do better work if they feel they are successful than they do if they have a feeling of failure. Success breeds success

is an old, but true saying. A sense of failure leads to dislike of a subject and if repeated, often develops in the student an inferiority complex regarding the subject. This frequently happens fairly early in the student's school career. The above comments should not be taken to indicate the author's belief that students' marks should be "boosted." Rather students at all times should be assigned marks (if it is necessary to assign marks) that are, as nearly as possible, representative of the student's true achievement.

A third group of instructors believe that no letter or numerical marks should ever be assigned to students. They believe that marks serve as a wrong, or at least, as an artificial incentive for a student to make his best achievement. Marks really mean very little specifically or even comparatively so they maintain (and there is much evidence to support this point of view). Other incentives than marks should be used to inspire a student to do his best. Other methods than marks should be used in obtaining relative ratings of students. This school of thought has been increasing in numbers in recent years. However, obnoxious as they may be, it would seem that marks will be assigned in secondary schools and colleges for a long time to come.

The first part of this study involved an examination of over 700 "border-line" mid-semester grades in a physical science survey course. "Border-line" cases were arbitrarily taken as being those students whose mid-semester point average was within 2.5 grade points of having a higher or lower mid-semester letter grade. For example the final marks of all mid-semester students who were within 2.5 points of making a "C" were compared with the final marks of all mid-semester "C" students who were within 2.5 points of making a "D" mark. The two groups might be called "D+" and "C—" students although "+" and "—" were not actually assigned. In a similar manner all "F+" and "D—," "C+" and "B—," and "B+" and "A—" marks were compared. Total gains were computed for each pair of grades. All marks were based upon the results of objective tests. Specifically, we wanted to determine, for example, if a "D" student with lowest possible "D" grade (within at least 2.5 points of an "F" mark) made the same, less or a greater gain than a high "F" student (whose mark was within at least 2.5 points of a "D").

The maximum difference between the pair of "+" and "—" grades compared was 5 points. Thus, the actual difference between a given pair of grades was very small. Our problem was then to determine what was the effect of a difference of one letter grade made at mid-semester (which really represented a difference of several grade points) upon a student's final mark, when the initial difference was 5 points or less. Did the higher letter mark act as an incentive to do better work? Would the student with a mid-semester mark of "C" (actually a "C—") work harder to retain that mark than a "D" (actually a "D+") student would work to get a "C" mark?

The number of students' marks compared under the "+" and "—" headings were 383 and 329, respectively. The marks were distributed over several semesters. The "—" group made greatest gains in 18 comparisons and the "+" group made greatest gains in 6 comparisons. When the total points gained by each group were averaged, the "—" group individually made 5 times the point gain made by the "+" group. The "F+" group as compared with the "D—" group made slightly more gains than any other "+" group, indicating that many "F+" students made increased effort to avoid an "F" final mark. The above results would give some evidence to support the belief that a higher mark does more to stimulate students to do better work than does the assignment of lower marks.

Possibly a better way to check this would be to deliberately lower student's mid-semester marks in one group and to

deliberately raise student's mid-semester marks in a second group then note the actual changes made in each group.

A study was also made to determine the relationship between the marks made at mid-semester to the mark made at the end of the semester. The marks of 3,758 students in a physical science survey course extending over the period 1937–1943 were compared. The results were as follows:

Mid-semester mark of A:285 cases.
235 A's, 46 B's, 3 C's, 1 D.
Mid-semester mark of B:675 cases.
173 A's, 335 B's, 157 C's, 9 D's, 1 F.
Mid-semester mark of C:1,399 cases.
23 A's, 258 B's. 897 C's, 205 D's, 16 F's.
Mid-semester mark of D:928 cases.
0 A's, 15 B's, 543 C's, 278 D's, and 94 F's.
Mid-semester mark of F:471 cases.
0 A's, 3 B's, 92 C's, 192 D's, 184 F's.

This indicates that a student's mid-semester mark will most probably be his final mark. A student with a mid-semester mark of A has over 8 chances in 10 of retaining that mark at the end of the semester, and almost no chance of receiving a C or D.

A student with a mid-semester mark of B has almost one chance in two of retaining that mark at the end of the semester, one chance in four of making an A or C, and only a slight chance of making a D or F.

A student with a mid-semester mark of C has a slightly better than an even chance of retaining that mark at the end of the semester, and about one chance in five of making either a B or a D, with some slight chance of making an A or an F.

A student with a mid-semester mark of D has more than an even chance of making a C at the end of the semester, no chance of making an A, and only a slight chance of making a B. He has one chance in nine of making an F, and slightly less than one chance in three of retaining his D. Thus, it will be seen that the D group contrasts sharply with the A, B, and C groups. This is partially accounted for by the fact that D marks one semester were considerably off balance and also, since the beginning of the war, many military students have been given full credit hours if they leave after two-thirds of the semester, and in marks there has been a tendency to give them the benefit of the doubt. The same applies to students with mid-semester marks of F, where the final mark averages are higher than the mid-semester marks. One may conclude from the above results that mid-semester marks in the physical science survey course have a high predictive value for the final semester marks.

BOOK REVIEWS

SYMPOSIUM. *Science and Life in the World.* New York: McGraw-Hill Book Company, Inc., 1946. 3 Volumes, 586 p. $7.50.

These volumes include addresses presented during the three-day program celebrating the George Westinghouse Centennial, held in Pittsburgh, Pa., May, 1946. Each volume has one or two subtitles toward which one day's program was directed.

Volume I "Science and Civilization—The Future of Atomic Energy", begins appropriately with "Scientific Ethics", by Dr. A. V. Hill of England. The first half of the subtitle is further discussed by Isaiah Bowman, Robert E. Doherty, Vannevar Bush, and I. I. Rabi. These world-known men, analyzing the perplexing problems of our day, have undertaken to tell us the ways in which humans need to accept science and plan its future in order that civilization may continue to advance. The second half of the subtitle deals with the future of atomic energy. The contributors, J. R. Oppenheimer, Enrico Fermi, W. E. Chamberlain, Hugh S. Taylor and Frank B. Jewett are representative of those scientists whose discoveries and sense of obligations relate to the facts and meanings of atomic energy. Dr. Oppenheimer discussed atomic weapons of the future, and Dr. Fermi followed by discussing atomic energy for constructive uses. An opening

paragraph by Fermi is significant. "If we try to look into the future and we take the optimistic point of view that mankind may succeed in organizing itself so as to eliminate the fear and the danger of atomic weapons, we might speculate as to what may be the development of atomic energy as a constructive force." Thus the author registers fear and hope concerning atomic weapons, then outlines the types of constructive uses toward which atomic energy may possibly be directed. This new source of power is already proved, is already being harnessed, though not yet effectively. The nature and quantity of this new source of power are such as to make certain that we are entering upon a radically changed period of man's industries, transportation, health and natural philosophy.

The first part of Volume II deals with "Transportation—A Measurement of Civilization". The achievements of aviation and its promise for the immediate future is presented by Dr. Edward Warner, President of the Interim Council, Provisional International Civil Aviation Organization. About a million passengers now use airplanes monthly. It is estimated that Trans Atlantic airplanes will carry two hundred thousand passengers in 1947. Transport of mail and merchandize is rapidly increasing. "It will still lie in the realm of human relations to determine whether the world is to be improved, but the airplane can contribute mightily to its improvement if it is in the hearts of its users to use it to that end." Control of airplanes and their routes of travel in times of peace will become more difficult with the increase of commercial and individual airplanes. The United States, the United Kingdom and Canada have agreed that they will not undertake to establish restrictive charges for use of the air above their lands. Suitable agreements by other countries are needed, since obvious difficulties would develop if different countries should undertake regulations in the form of charges for use of their air. Then there are presented frank statements of many structural improvements needed for airplanes of the future. Airplanes are not perfect machines.

Then follow "Ships and Shipping", by Vice-Admiral Emory S. Land, "Rail Transportation" by President of the Pennsylvania Railroad M. W. Clement; "The New American Way of Life" (Automobiles), by C. F. Kettering, General Motors; "Transportation Planning in Urban Areas", by City Planning Expert Harland Bartholomew; all these followed by a cogent "Commentary" by Robert P. Russell, President, Standard Oil Development Company. Those are deservedly eminent men, whose discussions are graphically factual and whose anticipation of what needs to be done gives anchorage for assertions about what has been achieved.

The latter part of Volume II deals with "Life, Light and Man". George W. Merck, eminent chemist, discusses "Peacetime Implications of Biological Warfare". Dr. C. B. Van Niel, Professor in Stanford University presents "Photosynthesis", and Dr. George W. Beadle of the same University discusses "High-frequency Radiation and the Gene". Then comes "The Microbe, Friend and Enemy of Man", by Dr. Selman A. Waksman, Rutgers University. Those three topics represent scientific areas of far-reaching unknowns but each with recent achievements of very great promise and expectancy. Dr. Linus Pauling, California Institute of Technology, recounts the astounding discoveries of "Molecular Architecture and Biological Reactions", by means of which chemical tracers are sent throughout the human body to bring back accounts of what takes place within the body. This Volume II of the George Westinghouse Centenary shows clear recognition that biological discoveries and their meanings are equally significant with physics and chemistry, and indeed inseparable from recent discoveries in the physical sciences.

Volume III may be characterized as almost a volume of achievement, prospect and obligation. The title is "A Challenge to the World". The fourteen speakers speak briefly of accomplishments of the century since George Westinghouse was born. Speaking of "Science and Civilization", President Price of the Westinghouse Electric Corporation said: "Cradled in these years of scientific awakening, George Westinghouse reached maturity at a time when these new developments could have—and did have—a profound effect on industrial advancement, and his career expressed the creative attitude that we hope this Forum will help engender in this day and age." Then follow discussions of the necessity for, and the ways through which present and future research must use team work rather than individual research. Different points of view are focused upon a problem. Different backgrounds of scientific training as well as different scientific experiences mean that two or more scientists may see two or more sides of a problem. Industrialists, technologists, inventors and engineers cooperating with science specialists increase the liklihood of enduring results. Thus the significance of "Partners in Science" by Dr. L. W. Chubb, Director of the Westinghouse Research Laboratories. Dr. Frank B. Jewett, President of the National Academy of Sciences, pushes back the boundaries in his "Horizons of Communications". "The Golden Age of the Future", by A. W. Robertson, Chairman of the Board of the Westinghouse Electric Corporation, says, "man has devoted his genius wherever it has appeared to improving his environment and not himself". That fact "is startling in the extreme." If there should be a golden age of the future, man must study himself and other humans as he has studied his environment. To President Karl Compton, Massachusetts Institute of Technology, was assigned the topic "Scientific Progress—Insurance Against Aggression and Depression". What an order for one good man! And the speaker promptly absolved himself from giving a full answer. Rather, he discusses different proposals by different groups who are seeking answers to

this problem. He strongly urges a National Science Foundation as a major start toward finding desired answers to problems of society as well as of science. And Dr. Compton urges that cooperative research directed toward society's benefit must not overlook the fact that it is in university laboratories where most of the enduring and foundational research is done, hence the need of maintaining proper perspective when considering the progress of science in relation to war, peace and prosperity.

Volume III and its predecessors contain many important units not even mentioned in this review. Indeed the three volumes contain so much highly valuable up-to-date material that a review can do no more than describe in part, illustrate meagerly, omit mainly, hoping that what is said may result in extended careful reading by many thousands who would benefit from the volumes. The volumes represent the highest achievement yet made in presenting worthy standards of cooperation between education, industry, invention, technology and fundamental science.

OTIS W. CALDWELL

NOLL, VICTOR H. (Chairman). *The Forty-Sixth Yearbook of the National Society for the Study of Education, Part I, Science Education in American Schools.* Chicago: The University of Chicago Press, 1947. 306 p. $2.50.

Science Education in American Schools is discussed at some length in the papers by Victor H. Noll, J. Darnell Barnard, Glenn O. Blough, Eugene B. Elliott, J. Cayce Morrison, and Samuel Ralph Powers published in this issue of Science Education. Possibly little needs to be added by this reviewer. One gains the impression from these papers that some disagreement exists as to the philosophies stated, the assumptions made, and the areas or aspects that have been overstressed or understressed in this Committee report. Nor is this surprising. It would be very much more surprising if there were complete agreement, for no leaders in any field are rarely if ever, in complete agreement. It may be said that the only possible way to have a wholly satisfying report or book is for that individual to write it himself. And there is more than a chance that he would even find himself in disagreement or dissatisfaction with himself when the work is completed. If one feels inclined to criticise, a book or a report such as this has much that may be criticised. Thus it was with the Thirty-First Yearbook and so it is with the Forty-Sixth.

As a whole, the reviewer believes the Committee did an excellent job and is to be highly commended for a sound and far-reaching report. The reviewer would have preferred a greater emphasis upon functional science, more attention to certain significant reports (see Power's article), a more complete analysis of problem-solving techniques and methods of teaching scientific methods and attitudes. A number of specific examples of these would be helpful along with experimental evidence of the validity of the assumed superiority of these phases of science teaching methods and purposes.

C. M. P.

LIGHT, N. SEARLE (Chairman). *National Society for the Study of Education, Forty-Sixth Yearbook, Part II, Early Childhood Education.* Chicago: University of Chicago Press, 1947. $2.75.

Outstanding specialists in elementary education and in community services have contributed to this yearbook. Important areas in services for children are given consideration in the fifteen well written chapters. From the beginning statement by N. S. Light of the State Department of Education, Hartford, Connecticut, the needs of young children in a democracy for development with guidance in home, school and community with freedom to make choices and to grow in responsibility for wise choices are given as essentials in building a world of brotherhood.

The importance of the first six years of life as the "personality and behavioral-building years" increases in emphasis in the citations of the authors. The expanding role of women in society, the disturbing factors in family security and stability, the uncertainty of world conditions and the growing recognition of the value of school and community services to supplement and extend individual and social opportunities for childhood point to the provision of earlier participation of schools in early childhood education through the provision of nursery schools and kindergartens as a recognized part of elementary education.

Research in child development is interpreted in relationship to better family life and to the improvement of school programs which meet the needs of young children. The yearbook will have great value to those who are willing to probe more deeply into the many resources which are revealed to all interested in the better understanding of children.

MARGARET HAMPEL

HIBBEN, FRANK C. *The Lost Americans.* New York: Thomas Y. Crowell Company, 1946. 196 p. $2.50.

In 1800 an unimportant tax collector in France named Boucher de Perthes picked a flint fist-axe out of the gravel of the Somme River in northern France. And thus began a long series of discoveries of the ancestors of man. This fist-axe, crude indeed and used for hacking or cutting, like the claw of an animal, was the first tool used by man—the first tool that reason taught him to make. Later it was ascertained that these fist-axe men lived roughly between the second and third great glacial periods. But as late as the Civil War, scientific thought still assumed that all of man's story could be covered by six thousand short years. Then came a relatively

rapid number of important discoveries—the Neanderthal skull near Dusseldorf; the Cro-Magnon cave men; the Pithecanthropus erectus or Java ape man of the Dutch East Indies; the notable skull found in Rhodesia, Africa; the Peking man found near Chicken Bone Hill in northern China.

With all of this evidence pointing up the antiquity of man in Asia, Africa, and Europe, what about the New World? As late as 1925, most American scientists, if asked when man first came to America, undoubtedly would have answered: "About the time of Christ, or slightly before." And this in spite of the known evidence of the Aztec cities, the Mayas of Yucatan and the Incas of Peru, or the Mound Builders. All of these are now known to be of relatively recent times—within the last 2,000 years, and in the case of the Mayas dating back for about 700 years or so for their maximum stage of development. So American scientists had come to the definite conclusion that human life in the New World was really very recent.

One very disturbing element inconsistent with this conclusion was the plant corn. Corn lay as the basis of the New World civilizations. It was highly developed by the Indians when Columbus found them. Hundreds of varieties, ranging from popcorn to sweet corn, field corn, and flint corn were all known to the primitive Redmen. They had developed varieties that would grow in the short summers of Maine, and other kinds that would survive the droughts and scanty rain of northern Mexico. How long did it take these Indians, who were ignorant of botany, to develop these strains? Again, corn cannot exist without the hand of man! Uncultivated and untended by humans, the corn plant has no way of dispersing its seeds. If the cobs drop at the foot of the stalk, the next year the young plants sprout so thickly there that they will not bear ears and soon die out. There is no such thing as wild corn! The botanists estimate that it took 20,000 years to develop corn from the primitive seed—bearing grass to the corn we know today. Indirectly this indicated someone here in the New World had fostered this development. But whom? Surely not the Indians, the Mayas, the Incas for reasons commonly accepted. Yet the first real men walked the gravel bars of the Somme River 500,000 years ago—some 497,000 or so years before the Mayas, Incas, or Indians.

Then a Negro cowboy in 1926 riding down a deep arroyo in northern New Mexico found a flint point that was to completely change the 1925 idea of the length of man's time in the New World. Later investigation showed this flint point to be totally unlike the arrowheads of the Indians. These flints, varying from an inch to three inches in length, obviously served to tip light javelins or spears. The bow and arrow, and arrowheads had not yet been invented. The flints of this "Folsom man" had been used to kill an animal, now known as Taylor's bison, which had been extinct for 10,000 years or so. The Folsom man was a mighty hunter and killed large, ferocious animals with the flint-tipped spears. He used the skins of the animals as clothing for protection against the wintry blasts of the receding glacial ice. Many other cites of Folsom man's habitation were later discovered. His path of migration was traced back up the American and Canadian prairies to Alaska—to a place opposite Siberia. The author goes to some length to disprove earlier theories that man first came to America by the Easter Island route, the Continent of Atlantis, or via the Mythical Pacific Continent of Mu.

Later on various off-shoots of the Folsom man were discovered—the Yuma man, the Cochise seed gathers, the Lake Mohave Men, the Abilene Man--probably country cousins of the Folsom man. Then came the discovery of still earlier men than the Folsom Man—the Sondia Cave Men of New Mexico where both had occupied the same cave at different dates—the Folsom Man at a much later date. The Sondia Cave Man probably dates back 25,000 years, near the very time of the last glacial retreat. Strangely enough not a single fossil—a skull, a bone, or even a tooth—of either the Folsom Man or the Sondia Cave Man has been discovered—although extensive search has been made all the way from New Mexico to Alaska. But hope exists that such a find will some day be made—and these early Lost Americans can be reconstructed.

At the time of the Sondia Cave Man and the Folsom Man an estimated forty million huge mammals now extinct, roamed the American continent—the mastodon, the great ground sloth, the tapir, the camel, Taylor's bison, the horse. But all disappeared—and rather suddenly at that. The author discusses various theories that have been held at one time or another for their disappearance. In many instances whole herds were apparently killed together, overcome as if by a common power. There seems to be no doubt that the major portion of the great animals of the Pleistocene met their end at the same time. The mystery as to what killed them seems to have attracted attention, even among the American Indians. Among the several theories to explain the tragedy are, (1) the ice killed them, (2) the vegetation disappeared, (3) earth-shaking volcanic eruptions of catastrophic violence, (4) parasites and disease, (5) fire. The author is inclined to the last named theory.

Altogether *The Lost Americans* is an intensely interesting story and is an excellent example of critical thinking and the use of the scientific method by scientists. Juniors and seniors in high school, as well as science teachers, and laymen can read the book both with enjoyment and profit.

C. M. P.

Eidinoff, Maxwell Leigh and Ruchlis, Hyman. *Atomics for the Millions.* New York: Whittlesey House, McGraw-Hill Book Co., 1947. 281 p. $3.50.

While *Atomics for the Millions* traces the story of the development of atomic energy in a manner similar to that of many recent books, it does represent a most excellent addition to this highly important and intensely interesting field. Whereas many of the recent books have emphasized, and rightly so, the potential destructiveness of the atomic bomb both in its explosive and heat effects as well as its radio-active dust possibilities, *Atomics for the Millions* aptly lives up to its title and at considerable length shows that atomic energy has many important uses aside from that of the *absolute weapon* of war.

The book does not assume any previous scientific or mathematical training and all unnecessary scientific terminology has been eliminated. With more than 100 graphic illustrations, the authors are tremendously interested in getting over their message to the masses—to the millions. To do this, they do trace the developments of man's atomic knowledge through the ages, with special emphasis on the highly intensified pace of the five war years.

In many ways the unique contribution made by this book is discussion of possible civilian uses of atomic energy and the part it is likely to play in our future economy. In this field the authors have done about the best job up to this time. They discuss interplanetary travel, tagged atoms in medicine, hope for cancer, possibilities of industrial and home power. And in these fields atomic energy may be as revolutionary as it has been in the field of war. If so, an unusual world lies just ahead of us.

Not only should all laymen be understandingly aware of the potentialities of atomic energy, but the science teacher—elementary, secondary, and college, needs to be particularly sensitive to these potentialities.

Atomics for the Millions should be a must for all science teachers, for libraries, and for all laymen who are not wholly insensitive to the vital forces now shaping their lives.

C. M. P.

Lawrence, William L. *"Dawn Over Zero."* New York: Alfred Knopf, 1946. 294 p. $3.00.

No one is better qualified to write an account of the atomic bomb for the layman than is Mr. Lawrence.

A science reporter for the *New York Times*, he has been called "The best scientific writer in America". He was the only newspaper man permitted by the War Department to go to all of the plants and inspect the processes of production of the atomic bomb, the only newspaperman allowed to witness the secret trial of the bomb in New Mexico, and the only newspaperman who witnessed the actual dropping of one of the bombs on Japan, from a plane above Nagasaki.

The title of the book is derived from the dropping of the test bomb at dawn over point zero in New Mexico—for from that hour the Atomic Age began.

A layman, science teacher, or science student will not find a more interesting, readable account of the development of the atomic bomb and the fulfillment of its final destiny in Japan. The peace-time uses of atomic energy can as yet only be dimly guessed. Twenty-one photographs add to the value of this unusually fine book.

C. L. D.

Borden, William Lischum. *There Will Be No Time: The Revolution in Strategy.* New York: The Macmillan Company, 1946. 225 p. $2.50.

This is the most challenging book that the reviewer has read on the problems created by the atomic bomb. The next time there will be no time to recover from the initial damage and shock and prepare for a great and glorious offensive as we did in World Wars I and II. For another war will begin and end with a rocket-Pearl Harbor that will bring instantaneous destruction to all of our great cities and industrial plants. As wartime weapons, cities and industries are obsolete. Their mission must be accomplished before the fighting begins or not at all. Victory will depend on quick elimination of the opponent's forces and stock piles in being.

C. L. D.

Miller, Merle and Spitzer, Abe. *We Dropped the A-Bomb.* New York: Thomas Y. Crowell Company, 1946. 152 p. $2.00.

This is the first eye-witness story of what happened over Hiroshima and Nagasaki as told by the radio operator Abe Spitzer of the *Great Artistle*, one of three planes that flew on these history-making missions. How the men felt, acted, what they thought as they sweated out their tasks on Tinian and as they carried out the two missions, is vividly told. There were long days of preliminary training, all the dry runs, the endless hours of waiting for the proper time, and the mystery that surrounded what the men close to the atom-bomb secret called the "gimmick." And when it was all over here is how the Glory Boys felt:

And there must have been many who, like me, had trouble focusing their eyes for awhile. There must have been thousands all over the Pacific, wearing OD's and khaki and Navy blues and Marine green who found things swimming before them. And who couldn't forget, even for a minute, even for a second, all the others who didn't hear the news, who would never hear the news, would never know, had died believing the day

would come but could never be sure. And who, in dying didn't ask for written guarantees, died for a reason they didn't exactly understand because nobody had ever bothered to tell them. Died for all the trite but meaningful words people say on the Fourth of July and on other occasions of the Year and at other times when patriotism pays. Died believing, never being sure but believing that someone else would collect the dividends.

And later:

The part that got me worst of all was when I saw that ball of fire.

I can't forget that pillar of smoke, reacting all the way up, not ever getting to the top of the sky, and I kept wondering if it would ever stop. And I wouldn't want to be too sure it ever did.

I couldn't help thinking about the people who had been living in those homes down there. They never knew what hit them. I knew they were Japs, of course, and you don't think much about Japs. They're your enemies and all, but I kept thinking about that and I still do. I guess I always will.

C. L. D.

CAMPBELL, JOHN W. *The Atomic Story.* New York: Henry Holt and Company, 1947. 297 p. $3.00.

Following the advent of the Atomic Age, there was a rush on the part of many writers to present the story leading up to the Atomic Bomb. Most of these accounts have been read by the reviewer, and most of them have been excellent. However, none of them has quite approached the completeness of *The Atomic Story.* This is a really complete course in atomic study told with unusual simplicity. The account is both most readable and soundly scientific.

Mr. Campbell is the editor of science fiction magazine, *Astounding Science Fiction.* This magazine in March, 1944, carried a story (*Deadline* by Cleve Cartmill) so knowledgeable on the nature of the atomic bomb that he was questioned by government agents as to the source of his exact knowledge. The author has always been interested in science and has written about it all of his life. As a hobby, he has an electronics laboratory in his basement. Photography is his second hobby.

Step by step the author traces the quest for atomic knowledge. Then follows a description of the making of the atomic bomb.

The author stresses the atomic radiation effects of the release of atomic energy as no other writer has done. At the same time the mechanical destructive possibilities of the atomic bomb are not underestimated. In fact, Mr. Campbell believes the bombs thus far used were really a crude sort of affair—mere toys as compared to what is easily possible.

Over 400 radioactive isotopes are known, and as a weapon death dusts, would seem to surpass the atomic bomb in their adaptability to military use. For example, if the dust of a certain carbon isotope were dropped on a city, no human being could enter that city for 5,000 years. By using other radioactive dusts, the life in a city could be destroyed by gamma radiations, and yet the city could be safely occupied in a little more than two weeks. A third great atomic weapon is the death spray—an atomic jet engine operating an atomic engine. Such a plane could knock out an entire enemy bomber formation by simply flying close to it. Armored columns could be wiped out by a single pass. By flying overhead it could make a city a death trap, and if it were shot down there would not be any city left.

Like all previous writers, the author states that there is no defense against the atomic bomb—even if one bomb gets through, the city would be destroyed. No defense has even been suggested. Active defenses today seem worthless, and that is the extremely vital difference between the atomic bomb and previous weapons. If it has atomic bombs, no nation is "little" any more. International control seems to be the only solution if civilization is to survive. In the last chapter the author discusses the human X in atomic politics.

This is a *must* book for every science teacher, for the school library, and yes, for every layman, too! C. M. P.

LUHR, OVERTON. *Physics Tells Why.* Lancaster, Pennsylvania: The Jacques Cattell Press, 1946. 387 p. $3.75.

First published in 1943, this atomic energy edition brings the book up to date. Explanations of hundreds of new things such as radar, atomic energy, diathermy waves, rocket bombs and jet-propelled planes have been added to the original edition.

This is one of the most readable and interesting popular treatises on physics that has been published. It is not surprising that the Jacques Cattell Press list it as the largest selling of all the popular science books bearing the Cattell imprint. Its readable style, apt illustrations, adequate coverage, and special quiz supplement at the end of the book make an unusual appeal to all of its readers. It is an excellent book for the high school science book shelf, the science teacher, the layman, and supplementary reading in physical science survey courses. R. J. A.

MILLIKAN, ROBERT A. *Electrons (+ and —): Protons, Photons, Neutrons, Mesotrons, and Cosmic Rays.* Chicago: The University of Chicago Press, 1947. 642 p. $6.00.

This is a classic in modern physics. Surely no student or teacher of modern physics or chemistry can afford not to be aware of the discoveries and conclusions arrived at in this book by one of the world's renowned physicists. Dr. Robert A. Millikan was awarded the Nobel Prize in Physics in 1923 for his work in isolating and measuring

accurately the electron and for his photoelectric work. For the last twenty-five years while Executive Head of the California Institute of Technology, he has been actively engaged in the study of the nature of the cosmic ray—a field in which he is the preeminent authority.

Modern physics began with four important discoveries: x-rays in 1895, radioactivity in 1896, isolation of the electron in 1897, and quantization of light (the photon) in 1900. The astounding developments in modern physics, including even the atomic bomb, stem from these basic discoveries. Nowhere else will one find so good and readable a treatise as this one on the experimental research and the present conclusions of scientists about the nature of electrons, photons, protons, neutrons, mesotrons, and cosmic rays. And the treatment is not so technical as one might suppose. By skipping a little here and there, any well trained high school physics or chemistry teacher (and many better high school students) can read most of the material with adequate comprehension. Physical Science survey teachers should read this book. It is an excellent book for any physical science teacher or student, as well as the high school and college science library.

The reviewer wishes to quote some important statements about cosmic rays: (1) Cosmic rays cannot either have originated within the stars or, for that matter, in any localities within the universe in which matter is present in appreciable abundance, (2) Cosmic rays come to us uniformly from all parts of the celestial dome and must have their origin in some sort of activity going on in the depths of space and certainly "beyond the Milky Way", (3) Cosmic rays have come from their place of origin in intergalactic space without much modification in transit, and (4) So far as our experiments have now gone, no results have been obtained from our studies in India, in South America, in Canada, in Mexico, or in the United States which are out of harmony with the predictions of the atom—annihilation hypothesis of the origin of cosmic rays.

C. M. P.

FRISCH, O. R. *Meet the Atoms.* New York: A. A. Wyn, Inc., 1947. 226 p. $3.00.

Meet the Atoms explains the whole background of experiment and discovery which led to the release of atomic power. There is a foreword by Dr. Lise Meitner, his cousin, who participated with Dr. Frisch in the discovery of nuclear fission, the key which unlocked atomic energy. Dr. Frisch, forced to flee Nazi Germany, went to Denmark, later to England, and finally came to the United States. Both Dr. Frisch and Dr. Meitner helped with the atomic bomb project However, this book does not discuss the atomic bomb.

The writer believes that the fundamental aspects of the nature of atoms can be understood by the average layman and that a very minimum of mathematics and technical terms are needed. He believes difficult problems can be made intelligible in relatively simple form, without detracting from their scientific accuracy.

The author has succeeded remarkably well in maintaining this standard of simplicity and accuracy. It is an excellent book for the high school science library, the science teacher, the science student, and the laymen who wants a better understanding of the basic concepts underlying atomic energy.

C. M. P.

MORLEY, SYLVANUS GRISWOLD. *The Ancient Maya.* Stanford, California: Stanford University Press, 1946. 520 p. $10.00.

In the steaming jungles of Yucatan developed one of the greatest civilizations of ancient times and one of the most remarkable of all times—the Maya. The author traces their shadowy history beginning in the third or second millenium Before Christ through the Old Maya Empire (A.D. 317–987), the New Maya Empire (987–1542) and their ultimate overthrow in the Spanish Conquest (1542–1697). Students and teachers in the field of Science will appreciate the discussion of superlatives. We find ourselves so often saying the largest this, the oldest that, the most beautiful something else. Some superlatives are absolute: the Empire State Building is the highest building in the world; while others depend purely upon personal opinions. Therefore in the author's selection of fifty Maya superlatives, the author assumes full responsibility for the selection, well aware that others will have equally good and perhaps even better lists of their own. For example of some of the fifty superlatives, Tikal is given as the oldest and largest city; Copan, the city where Astronomy reached its highest development, Uaxactum had the earliest astronomical observatory, and the highest building, Temple IV, at Tikal, had a height of 229 feet which was a great height considering that they had no beast of burden.

It is true that the Maya had domesticated the wild turkey and kept swarms of wild, stingless bees in special thatched huts near their homes, but they had not one of the beasts of burden which so tremendously helped man in the old world. Indeed, in all America there would seem to have been but two examples of the use of beasts of burden in pre-Columbian times—the llama used as a pack animal by the ancient Peruvians and the dog used by the Eskimos to haul their sleds. All of the tremendous building programs of the ancient Maya were acomplished without the aid of a single carrying animal other than himself. But what efficient beasts of burden the ancient Maya were! They carried on their heads great carved facade-elements weighing up to 200 pounds. I know this because their descendants today do precisely the same thing in the reconstruction work at Chicken Itza.

There were no metal tools. Metal, we have seen, was nonexistent in the Old Empire and in the New Empire, gold and copper and their alloys were used exclusively in making articles of personal adornment, or for ceremonial use, such as rings, beads, pendants, ear-plugs, bells, cups, plates, plaques, and the like.

The principle of the wheel was unknown to the ancient Maya, and most students of aboriginal American Ceramics are agreed that the potter's wheel for turning pottery was also unknown in pre-Columbian America. In his long, arduous journey forward from savagery to a civilized state, the first five steps by which man has advanced are generally admitted to be the following: (1) control of fire, (2) invention of agriculture, (3) domestication of animals, (4) tools of metal, and (5) discovery of the principle of the wheel.

The ancient Maya were acquainted with and enjoyed the use of only the first two steps toward civilization—fire and agriculture. The ancient Egyptians, Chaldeans, Babylonians, Assyrians, Persiand, Chinese, Phoneicians, Etruscans, Greeks, and Romans possessed all five of these "steps toward civilization." The Khmers of Cambodia and the builders of the great rock-cut temples of Java were the only other peoples beside the ancient Maya who developed, high civilizations in the wet tropics, but they too made daily use of these five primary aids to civilization. In comparing the Maya and the Neolithic people of the Old World, no Neolithic people of the Old World ever reached such heights of cultural achievement as did the ancient Maya of middle America.

The Maya culture is compared with that of the Aztec and Incas as to architecture, highways, sculpture, ceramics, textiles, painting, and other forms of art, metal work, and gold jewelry. In architecture, sculpture, painting, feather work, lapidary art, cotton weaving and dyeing and possibly ceramics, the Mayas were definitely superior.

When we come to abstract mental achievements, such as writing, astronomy, arithmetic, the development of a calendar and chronology, and the recording of historical events, the Maya has no equals anywhere in ancient America. In Astronomy they surpassed the Egyptians and the Babylonians. Their calendar was more accurate than our present Gregarian calendar being exact to the day over a period of 374,440 years! The Maya were the first people in the world to develop a system of positional mathematics involving the concepts of zero, three different symbols for which they had devised nearly a thousand years before the Hindoos invented decimal notation in India in the eighth century after Christ, and fifteen hundred years before Arabic numerals and decimal notation reached Western Europe by way of Spain and the Moors.

The author develops the theory that this great civilization and culture was made possible by their system of agriculture and the growing of Maize or Indian corn. Maize was the keystone of Maya culture being 75 to 85 per cent of their food intake. He could produce the corn by working 76 days, or if no livestock to feed, in 48 days. In short, he had between 293 and 317 days out of every year for non-food producing activities. Thus the ancient Maya were primarily farmers.

Here is the surplus time—roughly nine to ten months—during which in both the Old and New Empire periods, the pyramids, temples, palaces, colonades, ball courts plazas, and causeways were built.

What caused the downfall of such a remarkable civilization? Many causes have been proposed—change of climate, disease, and so on. Dr. Morley cites evidence that the end of the Old Maya Empire was brought about by failure of the Maya agricultural system. The repeated clearing and burning of ever-increasing areas of forest to serve as corn lands converted the original forests into man-made grasslands, artificial savannas. The Mayas had no implements whatever for turning the soil—no hoes, picks, harrows, spades, shovels, or plows. Economic failure—the law of diminishing returns, the high cost of living—finally forced migration to other regions. A similar cause was an important factor in the downfall of the New Maya Empire, accompanied by local wars and strife, and no organized resistance to the invasion of the Spaniards.

The book is fully illustrated with photographs, drawings, maps, charts, diagrams, and text figures. For forty years, Dr. Morley has been exploring the jungles of Guatemala and Mexico, delving into the ruins of the Mayan civilization gathering material for this book. Dr. Morley's book is a landmark of American scholarship. He has done for the Maya civilization what Dr. Breasted's monumental History of Egypt did for the ancient culture of the Nile Valley, which is the standard authority on the latter subject.

C. M. P.

ADAMS, J. MCKEE. *Ancient Records and the Bible.* Nashville: Broadman Press, 1946. 397 p. $3.75.

Scientific excavation and exploration by archaeologists in the Near East have added much confirmatory proof to statements made in the Bible which previously had been more or less questioned by sceptical historians. Concrete evidence has been uncovered that make the descriptive statements found in the Bible about living conditions and past events rest on the firm ground of substantiated evidence. It is now recognized that biblical statements of contemporary conditions and historical movements can be true even when unsupported by other contemporary records known to the scholarly world. Thus has science come to the aid and support of the Bible—adding its corroboration of biblical statements and its

contribution has been to enhance the historical value of the Bible on every hand. To those who have assumed Science and the Bible to be in unreconcilable conflict this evidence of supporting confirmation may come as a shock; to many others, seeing no conflict, the evidence comes as a happy confirmation that the statements are not folklore, legend, or exaggerated tradition.

Step by step the author shows how archaeological findings fit into confirmed historical statements and biblical assertions. The book has numerous photographs and every evidence of scholarly, documented proof for the assertions made and the conclusions stated. Surely many people in Science as well as Bible students will welcome this scholarly work.

C. M. P.

GOODSPEED, EDGAR J. *How to Read the Bible.* Philadelphia: The John C. Winston Company, 1946. 244 p. $2.50.

Few, if any, interpreters and translators are as well known as Doctor Goodspeed, student, teacher, eminent authority in Latin, Greek, Hebrew, Assyrian and other Semitic tongues. Author of more than fifty books, Dr. Goodspeed is best known for his modern translation (with J. M. P. Smith) of the Bible. This important book *How To Read the Bible* is based on a lifetime of study and research.

He states that the sheer bulk of the Bible—1100 pages of double-column fine print is a determent to many. Its books are, moreover, of a perplexing range and variety, and the most familiar and interesting do not start at the beginning. Thus people respect it and want to know it, but they are disinclined to plow through more than 750 pages to get to the part that really interests them. The author then says: "The obvious way to read a book is to begin at the beginning and read it through; to look at the end to see how it is coming out is weakness.

But the Bible is not a book; it is a library. How do you read a library? Certainly not by taking the catalog and reading the first book listed in it, then the second, and so on. Nor do you read it shelf by shelf, beginning in the upper left hand corner. You follow some definite interest of yours, or you decide upon some principle to guide your reading.

The Bible has all of the range and variety of a library. It was written on two continents in three languages, by a hundred authors, scattered over a thousand years!

So Dr. Goodspeed suggests beginning with the Gospel of Mark in the New Testament. Then he undertakes a literary and historical walk among the various books of the Bible, taking up the chief books in it as biography, oratory, history, poetry, drama, fiction, letters, and vision.

C. M. P.

PICARD, MADGE E. AND BULEY, R. CARLYLE. *The Midwest Pioneer: His Ills, Cures, and Doctors.* New York: Henry Schuman, 1946. 339 p. $3.75.

This book was first published in a limited edition which was immediately exhausted and is now available in a revised and corrected edition.

As the pioneer advanced into the virgin forests and far reaching prairie lands of the Middle West, he was faced with many problems. In the early days there was a terror. For almost two centuries the Indian had been a part of the environment; the struggle with him was a conditioning factor as important as the climate, the topography, and the vast distances in determining the character of the American pioneer.

There was the task of chopping, grubbing, and hewing a home out of the wilderness, of getting enough food to carry a domestic economy which would make that home in a large measure self-sufficing. In time came the necessity of acquiring title of land; of laying hands on enough money to pay for it.

Obtaining cash required man's getting produce to market—roads, boats, canals, railroads—the business of transportation. There was the need for governments, local and state, of men and money to run them; of schools, lest the next generation grow up savage and ignorant. More basic than any of these problems, however, was that of health. Unless the settler survived, all other problems were relagated into insignificance; he simply never got around to them. The pioneers came into the great central lowland region and in swampy areas, and found it a disease—malaria infested area.

The malaria and the shakes, with chills and fever, plagued them but their pride caused them to be reluctant to report sickness in their own localities; it was usually somewhere else. During small pox epidemics large numbers of their people died. They learned from the Indians that certain herbs were cures for specific diseases. Superstition, faith healers, and quacks of every description found the poor people ready prey. The regulars, those trained to practice medicine, had an uphill fight. The doctor traveled night and day over bad roads and often times was unable to collect anything for his services. But good men and good doctors finally organized medical colleges and trained other doctors to carry on where they left off. In spite of the patent medicine craze and ignorance on every hand, the people, always very active, began to get control of health conditions. Swamps were drained, cities cleaned up, better water supply and sewage disposal was provided and with better economic conditions in general the health of the people greatly improved.

But even yet today health conditions in the Middle West are none too good. There are large areas that need fewer quacks and more

honestly trained doctors—this is true of both rural areas and cities in the Middle West.

Practices in the art of curing and healing in the pioneer Midwest was characterized by all of the fads, quackeries, superstitions that have been common to medical practices down through the ages—bleeding, herbs, blisters, patent medicines, and what have you. Many doctors were honest, but as many were frauds as they themselves well knew. To have a complete picture of the life of the early pioneers, one must be cognizant of the part played by medicine men and doctors as they rode horseback from one remote community to another. These men played an important part in the lives and thinking of the midwestern pioneer. Considerable space is devoted to the development of medical colleges, the placing of the medical profession on a reputable basis, and the final disappearance of the patent medicine man.

Descriptive of a period now gone, this is a most readable account of the history and practice of medicine.

F. M. D.

BAXTER, JAMES PHINNEY. *Scientists Against Time.* Boston: Atlantic-Little, Brown and Company, 1947. 473 p. $5.00.

This is the book that the reviewer has been waiting for ever since the close of the story of the part that American science played in winning that war—a story of death—dealing and life-saving devices that contributed to victory in World War II. This book reveals the official story of O.S.R.D. (Office of Scientific Research and Development). And what a thrilling story it is! Undoubtedly the side having the best scientific and technical knowledge, the "know-how" of using that knowledge, won the war. Let's hope that both our military leaders and our political chieftains will not soon forget it, either.

So here for the first time is the whole story of the development of each new weapon and instrument as each new emergency demanded it: how radar saved the day; how the German U-boat packs were defeated; here is the true story of the rocket; of why poison gas was not used; of the incendiary and the flame thrower; the Duku and Weasel—the life-savers on the beaches; the proximity fuse which helped to stop the break-through in the Bulge; the Atomic bomb; and finally, but not least, the story of military medicine. Nearly 75 photographs supplemented the textual material.

This book along with one or two top-notchers on the atomic bomb should be a *must* for every science teacher, and for every library. If not the best non-fiction book published since the end of the war, the reviewer believes it can be challenged only by one or two of the stories on atomic energy.

C. M. P.

DUPUY, COL. R. ERNEST AND BREGSTEIN, LT. COL. HERBERT. *Soldier's Album: The Shaef Pictorial History of the War in Europe.* Boston: Houghton Mifflin Company, 1946. 173 p. $5.00.

This is a nine-by-eleven size book; a pictorial history of the war in Europe. The story of the war is chronologically and graphically told. But the soldiers who are pictured and actually experienced the battles, the blood, sweat and tears won't perhaps care much for the album or the pictures. It is something they want to forget. For those soldiers who were not overseas and the rest of us, it is a record of the war that we should see and do something about. We should resolve to fight war. War, the chief cause of which is economic then political and social. Surely good will and the intelligence of man can outlaw war and will during our time.

Col. Dupuy has now retired to his farm in Bridgewater, Vermont and is engaged in further writing.

Lt. Col. Bregstein is now executive editorial assistant to Walter Annenberg, who is editor and publisher of the Philadelphia Inquirer, and President of Triangle Publications.

The book contains nearly four hundred photographs with a running commentary of text which creates a coherent story of what happened in the Battle of Western Europe between June 5, 1944 and May 8, 1945. The scenes and faces shown in the book will be familiar to many officers and soliders.

F. M. D.

MORGANTHAU, HANS J. *Scientific Man vs Power Politics.* Chicago: University of Chicago Press, 1946. 245 p. $3.00.

Neither science nor ethics nor politics can resolve the conflict between politics and ethics into harmony. Scientific man, forever in search of the philosopher's stone, the magical formula which will provide scientific certainty in an uncertain world is trapped in the blind alley of his own philosophy. Dazzled by the success of the scientific method in solving the problems of the material world he applies the methods of the physical sciences to the problems of the social world and hopes in vain for the same results.

From the fundamental concept that man and the world are governed by rational laws which human reason is able to understand and apply, rationalistic philosophy draws four conclusions. First, the rationally right and the ethically good are identical. Second, that the rationally right action is of necessity, the successful one. Third, that education leads man to the rationally right hence, good and successful action. Fourth, that the laws of reason, as applied to the social sphere, are universal in their application.

Modern faith is founded upon three miscon-

ceptions of rationalist philosophy: The understanding of the nature of man; of the nature of the world, especially the social world; and finally, of the nature of reason itself.

Power politics, which is rooted in the lust for power common to all men and the conflicts which it breeds are of the very essence of human life in society.

Scientific man—the social engineer—must give way to the more-than-scientific man—the statesman. With the political wisdom to act successfully, with the moral courage to act though he knows all political action is evil, and with the moral judgment to choose among several expedients the least evil one, the statesman can reconcile man's political nature with his moral aspirations, his weakness with his strength, and create a new society.

C. L. D.

WHITEHEAD, ALFRED NORTH. *Essays in Science and Philosophy*. New York: Philosophical Library, 1947. 348 p. $4.75

The essays contained in this volume represent a cross-section from the career of one of the world's most distinguished philosophers. Some are of biographical nature, and others treat of perennial philosophical problems. Here are the author's thoughts on the meaning and future of learning; and finally, some of his basic theories in the science of mathematics.

Part I dealing with personal essays is especially delightful reading, as the 86 year old philosopher reflects on his earlier education, experiences, and thinking. Part II, entitled *Philosophy* considers Immortality, Mathematics and the Good, Process and Reality, John Dewey and His Influence, and Analysis of Learning. Part III considers *Education*: The Study of the Past—Its Uses and Its Dangers, Education and Self-Education; Mathematics and Liberal Education; Science in General Education; Historical Changes; and Harvard: the Future. Part IV discusses *Science*, emphasizing especially certain basic concepts in Mathematics.

All of the essays, with the exception of those dealing with Mathematics, are non-technical. They are enjoyable, stimulating, thought-provoking.

C. L. D.

PLEDGE, H. T. *Science Since 1500*. New York: The Philosophical Library, 1947. 357 p. $5.00.

Falteringly, hesitatingly, often bewilderingly science has come along a long and arduous path since its birth in the ancient past. Written records are fairly recent, but man knew much about the world in which he lived long before he thought of setting down his observations, beliefs, and theories in written records. The author confines his discussions largely to the developments in science since 1500, and for the most part that which is of most signficance has happened since Columbus discovered America.

The author, Librarian of the Science Museum of London, traces the fascinating story, interestingly told of the epoch—making theories, discoveries, and inventions in biology, chemistry, mathematics and physics. A great deal of information not found in similar treatises on the history of science is presented. The account will be of interest to all science teachers and is not too technical or mathematical for the layman.

R. J. A.

ALLEN, CHALINDER. *The Tyranny of Time*. New York: Philosophical Library, 1947. 275 p. $3.00.

Time is an *Idea* consciously conceived by man. Time is man's idea of his own frustration. All man's life is spent in fighting *Time*. But he can never destroy it. Time has been feared, glorified, idolized in turn. "Time will tell." "Time heals wounds". "In Time we trust". Time to get up! Time to eat! Time to go to class! Time to work! Time to retire! Time to pray! Time to sleep. Verily the tyranny of Time is a slavery imposed by ourselves upon ourselves. Time is not "past." What we call Past Time is really no longer in being. It is merely our memory-idea of former place-moments of Time. Similarly Time is not "future". What we call "Future Time" is really not in existence yet. It is merely our imagined-idea of a hoped-for or expected place-moment of Time. Time is only a moment reality.

The author develops the idea that Time is the energy-idea of this earth. Man is conscious of that energy-idea when he experiences sensations caused by gravitational-energy, namely all the sensations which are based on a continuance of the feeling of Weight. Heat-energy is the midway condition of all kinds of energy, the resting energy, latent or potential! If man could completely control all heat on earth he would be complete master of the earth and all that is on it. Undoubtedly he would then be the master of Time, in a way that no amount of other physical work and accumulation of money-power or leisure could make him.

C. L. D.

BARBOUR, THOMAS. *A Naturalist's Scrapbook*. Cambridge: Harvard University Press, 1946. 218 p. $3.00.

"One of the most important functions of a museum director is to bring about the transfer of material which is scientifically important from unappreciative to appreciative, and *safe*, ownership." With this sentence the late director of Harvard's Museum of Comparative Zoology opens the first of the essays which constitute this volume.

Like his earlier, more formal, autobiography, *Naturalist at Large*, this "Scrapbook" makes

fascinating reading for anyone interested in museums and their work—and who isn't? Barbour describes himself as a "pack rat, a frank and unashamed pack rat." His humor infuses the whole volume, whether he is poking fun at the name of his museum or chatting about one of its research men who concealed his dissections under a newspaper and saved crusts from his lunch for years in a large jar, in a way that might so easily have been ridicule but which only elicits chuckles.

This is the scrapbook of a many-sided and busy man who found time in the course of an extremely full life not only to fulfill an ambition on his first visit at the age of twelve—of running the Harvard Museum—but also to raise a family, to write, hunt, fish, and collect books. Herein are told the story of the founding of the Museum; the procession of the great and the near-great who have walked its corridors: Louis Agassiz, whose magnetic charm got the money for the Museum from the penny-pinching Yankees of the general Court of Massachusetts; Alexander Agassiz, whose carriage arrived and departed with clock-like regularity; Samuel Garman, whose eccentricities are referred to above; the story of two other famous collections—the Boston Museum of Natural History and the Peabody Museum in Salem; reflections on the transitory character of museum labels; and lively, personal accounts of some of Barbour's many collecting expeditions—to the Spice Islands, to Bali and Lombok, which he calls the "heavenly twins," Taboga, and other islands and far places of the earth.

He quotes, with approval, what his daughters propose as the requirements of a good museum exhibit: one which either recalls a pleasurable experience of the visitor or which is arresting in novelty and beauty.

The chapter on "Rare and Historic Birds," which recounts stories of the specimens of now-extinct species to be seen in the Museum, is outstanding in interest.

For enjoyment and informative value, this is a capital book

M. E. O.

PARKER, GEORGE HOWARD. *The World Expands.* Cambridge: Harvard University Press, 1946. 252 p. $4.00.

The World Expands are the recollections of a zoologist. The author is Professor of Zoology, Emeritus, Harvard University, and one of America's best known zoologists. He is the author of eight books and hundreds of scientific papers dealing with the anatomy and physiology of nervous organs and animal reactions. In 1937 he was awarded the Elliot medal of the National Academy of Sciences and in 1941 the Lewis award of the American Philosophical Society. He was President of the American Zoological Society in 1903, President of the American Society of Naturalists in 1929, and President of the American Academy of Arts and Sciences in 1933.

Born in Philadelphia in 1864, he attended Friend's Central School, and was a Jessup Fellow in the Philadelphia Academy of Natural Science. He entered Harvard University in 1883 and received an Sc.D. in 1891. Starting as an instructor in zoology in 1888, he became a full professor in 1906. Admitting his literary style can be describd as clear, he protests that it is not picturesque, poetic, or even interesting. The reviewer agrees most heartily with the author, that his style does have unusual clarity, but he disagrees most emphatically when he says his style is lacking in interest, for this portrayal of his life as a student, investigator, and teacher of zoology holds the reader's interest from beginning to end. Here the author makes the reader re-lived with him his difficulties, disappointments, satisfactions, and compensations. He says he has often tried to evaluate that which we have by birth and that which we acquire from social contact, and has come to the conclusion that we are perhaps about nine-tenths inborn and one-tenth acquired. He believes that our educational systems can, at best, offer only a favorable environment in which the growing individual may expand.

F. M. D.

CANTOR, ALFRED J. *Cancer Can Be Cured.* New York: Didier, Publishers, 660 Madison Avenue, 1946. 175 p. $2.50.

The key that unlocks the first door in the prevention of cancer is to prevent chronic irritation and you will prevent most cancers and the author further states, what we need today is not a cure for cancer, but to find cancer while it is curable.

The author advises women to prevent breast cancer, to nurse their children as long as they possibly can. "Let your physician, not your bridge partners be your guide," the author admonishes.

Rules are given to detect and prevent cancer of various parts of the body. Avoid going to any doctor who does not have adequate training and equipment to properly examine and diagnose your case.

"The public must be made to realize that only surgery, x-ray, and radium, in the hands of the skilled M.D. will cure cancer. They must learn that only the early case will be cured. They must know that only a fraud will guarantee cure; only a quack will show testimonials. The public must be educated to these facts. That is the sole purpose of this book," states the author. As such it is a most timely book that might well be in every library and in every home. Many lives might thus be saved and untold suffering by thousands avoided.

F. M. D.

ROBINSON, VICTOR, M.D. *Victory Over Pain: A History of Anesthesia.* New York: Henry Schuman, 1946. 338 p. $3.50.

This is an interesting book told largely in story form, showing developments in the field of anesthesia from the earliest times to the present. Six sections are devoted to early developments through the 17th and 18th centuries. While ether was discovered in the 16th century, its anesthetic properties were not discovered until 300 years later. Early developments sketch the use of drugs and narcotics—hellebore, dittany, opium, mandrake, hemlock, henbane, mulberry, lettuce, hops, bashish, and so on. Some illustrations show a crude mechanical trephining of the skull; an amputation of a leg with a saw like our present meat saws—the man strapped in a chair to prevent movement; and a clamp used for compression anesthesia—all before the discovery of anesthetics.

The second part includes four sections describing the work of Davy, Hickman, Mesmer, and others, under the major title of "On the Threshold." The next four sections—"The Discovery"—give accounts of the efforts of Long, Wells, Jackson, and Morton in story biographical form, with a final section on the "Controversy" as to who really first found that ether could be used as an anesthetic—an American discovery.

"The Reception of the Discovery in Europe" devotes four chapters to the work of Liston and Pirogoff and developments in Central Europe and France. Sections 20 to 24, inclusive, sketch the discovery and use of chloroform—the work of Guthrie, Simpson, and Snow particularly, with a final section on the deaths caused by inexperienced and improper use of earliy anesthetics.

"The Beginnings of Local Anesthesia" describes the work of Richardson and Keller in that field.

The next ten sections give story accounts of techniques of administration with improvements made; twilight sleep, caudal, endotracheal, rectal, intravenous, spinal, and refrigeration anesthesia.

Three 20th century anesthetics are mentioned and discussed briefly—ethylene, cyclopropane, and divinyl oxide. The last chapter gives an account of the new uses of curare.

An added epilogue—"Musings by the Nameless Monument" (monument to Ether in the Public Garden of Boston) sums up the book in a philosophizing mood of the author. One paragraph is as follows:

"Continual training is needed by the doctors, dentists, nurses and technicians who bring the patient to the gates of sleep through anesthesia. Eternal vigilance is the price of safety in anesthesia. The ancient legend of Sleep as the twin-brother of Death gains a new meaning in the slumber of Anesthesia."

A bibliography of 82 entries is given in the appendix.

A. W. H.

WARD, HAROLD, Editor. *New Worlds in Medicine.* New York: Robert M. McBride and Company, 1946. 707 p. $5.00.

This is an anthology of 34 articles by as many different authors touching many phases of medical discovery and practice:—overviews of general development; war discoveries including aviation and surgery; blood analysis; new clinical devices; physics and chemistry in medicine; new horizons in micro-biology and communicable diseases; glands, cancer, and growing old; anesthetics, antispetics, and diet therapy; alcoholics, psychiatry and mental hygiene; and steps forward in graduate study for doctors, preventive medicine, socialization of medicine and public health. The last revolves around Russian developments primarily, with definite implications for our own country. "Twenty-five years of medicine in the service of an entire people, without restriction of race, creed, or nationality, is an achievement which cannot be safely ignored . . . " We may well learn from Russia.

Each of the sections is interesting and much worth while, and written generally in non-technical language by a competent authority in the field. McCollum, Riddle, Carson, Sigerist, and Clendening are a few of the contributors whose mention will give some conception of the quality of the materials included.

Prominent in the selection of the chosen articles is the general viewpoint of the social importance of health conservation, preventive medicine, and nationwide planning to provide for all the people and to raise the quality of the population as a whole. Not primarily a doctor-private patient relationship is the focus of attention in the articles, but a "sociology of medicine" is "implicit in every chapter."

While this book is intended for the general public, it is a splendid reference for schools and colleges. It could well find a place among orientation or survey courses. It represents a field too often neglected in so-called general education. Can the health of a nation be left to the medical profession alone without the general education of all the people in its nature, its opportunities, and its problems?

A. W. H.

MALTZ, MAXWELL, M.D. *Evolution of Plastic Surgery.* New York: Froben Press, 1946. 376 p. $5.00.

This is a history of plastic surgery from the earliest periods of time. The mutilations of war and accident seem to have brought about the need for surgery, to restore the body parts disfigured, to their former state as nearly as was possible. Early East Indian, Egyptian, Assyrian, Greek, Roman, and Arabic developments are sketched to explain the origins of the modern arts of plastic surgery. Some details and summaries are given for each century, thereafter, beginning with the middle ages and the thirteenth

century. The accounts are largely biographical, showing the contributions of individuals in the step-by-step development. One hundred eight illustrations are included to make the descriptions more understandable. At the end, 30½ pages of chronology are given as a general overview and summary, with the name of each contributor.

Disfigurements of the nose and face seem to have played an important part after aesthetic tastes began to take their place in human culture patterns. Technics of repair, and instruments developed to use, are important elements in the total story. And the depredations caused by various types of diseases and infections, and bad health practices among the people are pointed out with considerable clarity. The growth of the concepts of doctor and surgeon is also indicated in some detail, together with anesthesia and bacteriology. A special chapter shows developments during World War I; and some changes during World War II, due to new weapons and modes of warfare—the bomb for example—are suggested. "World War II, burns and the complications following them comprise an important part of the casualties."

Pages 295 to 326 give pictorial examples of reconstructive surgery today—protruding ears, relaxed tissues, cleft lip, cysts, nasal deformities of various sorts, cauliflower ears, mouth contractures, webbed fingers, deforming scars, baggy eyes, and so on.

The book is of particular interest to the specialist, but reveals to the layman, even after a rather cursory examination, a general overview of the historical growth and importance of this specialist's realm of activity.

The author is Director, Department of Plastic and Reconstructive Surgery, West Side Hospital and Dispensary. A native New Yorker, educated at Columbia University originally, he has had post graduate work in England, France, Germany, and Italy, and is still connected with universities in the West Indies, Mexico, and South America.

A. W. H.

FABRICANT, NOAH D. AND WERNER, HEINZ. *A Treasury of Doctor Stories.* New York: Frederick Fell, 1946. 500 p. $3.00.

Here is a new departure in anthologies—a collection of stories about doctors, nurses, and patients, delightful, dramatic, and intriguing stories by such writers as Cronin, Maugham, Hemingway, Pearl Buck, Benet, and many other top-notch authors. Some of the stories are factual, others are imaginary, whimsical, touching, and gay. It is a book for anyone who enjoys good reading, for the authors were not interested in medical science as such but in a tale well told. To illustrate the experiences described in this rich collection of stories, Ernest Hemingway describes a skillful operation with a jack-knife while Arthur Schnitzler reveals a disconcerting confession in "The Death of a Bachelor." Some of the stories are rare, some old, others popular favorites. Dr. Fabricant is a prominent physician and litterateur while Heinz Werner is Book Club Editor of *The Chicago Sun.*

G. O.

SLAUGHTER, FRANK G. *The New Science of Surgery.* New York: Julian Messner, Inc., 1946. 286 p. $4.00.

Is surgery too expensive? Good surgery is either quite costly or entirely free. The author explains why this is true. In the same chapter we learn about the expense and time required to really train a good surgeon. If you need an operation, the book tells how to secure the best surgeon and care. The cause and cure of varicose veins and cancer are told in such a way that even the average layman can understand. Sciatica, bursitis, and neuritis are painful diseases which require careful diagnosis and treatment.

Perhaps one of the most interesting topics discussed in the book is psychosomatic surgery. Many women in caring for their own health and that of their families have many times gone to the doctors office when to have gone to the kitchen and prepared better and greater quantity of food would have been a much wiser thing to do, or even to have taken a walk and continued such exercise daily for a while. A great surgeon has laid down as a dictum for students that the true measure of a surgeon's ability is not in knowing when to operate, but when not to operate. The psychologists say, "The abdomen is the sounding board for the emotions." A right-sided pain complex may lead to a series of operations which will leave the individual, usually a woman, a complete surgical and pathological cripple, doomed to be a fretful invalid. Psychological questioning revealed what should have been found out in the first place—that her trouble was really emotional rather than organic. The phrase "to remove a cyst from the ovary and suspend the uterus, removing the appendix at the same time," should be a tip off to any woman to go home and blame the whole thing on her emotions. Some cases diagnosed as above require operations but their number is small. Many outstanding specialists in surgery of the reproductive system do not perform half a dozen such operations a year. Yet look at the operating schedules in any city general hospital in the country on almost any morning—and draw your own conclusions.

Science and skill are necessary to surgery. Surgery means trained fingers, shining instruments, an amphitheater tense with the drama of life and death. Yes, surgery is all this. Without the skill of the surgeon's fingers, there would be no surgery, no lives saved. But without science there would be no way for that skill

to operate. Three great conquests, without which surgical science would have been powerless to continue its progress are the conquests of shock, of pain, and of infection.

Dr. Slaughter has been a practicing civilian surgeon, chief surgical officer at one of the Army's largest camps and on a hospital ship in the Pacific. He has written five highly successful novels in his spare time.

F. M. D.

STEFANSSON, VILHJALMUR. *Not by Bread Alone.* New York: The Macmillan Company, 1946. 339 p. $3.50.

Not by bread alone but for the most part by meat alone, the Eskimo lives. The meat diet alone prevents them from having scurvy. They do not have a daily diet of various meats, but the variation is seasonal. For example, when the caribou are available caribou meat is their chief food. Later seals, walrus, and fish and perhaps for a month bird's eggs constitute the main food. However some Eskimos may eat seal meat all the year. The head of the caribou is especially liked and in descending order of preference come brisket, ribs, pelvis and backbone. The sweetest meat is nearest the bone. Beginning by what is least desired by the family, the dogs get the tenderloin, lungs, liver, and sweet breads. To hunting man, the marrow of the long bones is the greatest delicacy he knows, except perhaps boiled moose nose, or the boiled liver of the loche, a fresh water fish which has a large, fatty liver. It is a favorite food fish of the Eskimos of Northern Canada and Alaska.

Karsten Andersen and Vilhjalmur Stefansson, under the study and direction of physicians, lived on a meat diet in New York City for a year. They were in good health. Just as Stefansson could live on meat alone in the Arctic, he could also do so in New York City with no harmful results.

He interestingly tells about how the Eskimo had certain meat-eating habits which he, an explorer, at first could not adopt, but later on as a matter of convenience did so, only to find it tasted better than he had thought it would, and that it was good for him.

The author states that he verified for himself subjectively during the New York experiment that meat is a stimulating food—"it seemed to me that I was more optimistic and energetic than ordinarily. I looked forward with more anticipation to the next day or the next job, and was more likely to expect pleasure or success. This may have a bearing on the common report that the uncivilized Eskimos are the happiest people in the world." "Our stamina increased with the lengthening of the meat period," the author further states.

The chapter about teeth is worth all that the book costs. Teachers and parents need to become more enlightened about food, and the teeth.

A bibliography of works quoted or those that have a bearing on matters discussed in *Not by Bread Alone* is given in the back of the book.

In this book is related how Nansen and Johansen wintered in the Franz Joseph Islands 1895–96. They had lived in a hut of stones and walrus leather. The ventilation was slight, to conserve fuel; the blubber fire smoked, so that the air was additionally bad; within the house there was not a ray of daylight for months, and the two men practically hibernated, seldom going outdoors at all and taking as little exercise as appears humanly possible; they never bathed and seldom washed face or hands. Yet their health was perfect all winter, and they came out of their confinement in as good physical condition as any man ever did out of any kind of Arctic wintering. Their food had been exclusively the fat of walrus, eaten fresh and usually boiled. I think he proves that meat in the diet is more important to health, stamina and physical well-being and the prevention of scurvy than lime juice, fruits, cleanliness, ventilation, etc. A meat (lean and fat diet) fresh, dry, raw, or boiled—will prevent scurvy.

The Eskimos eat their meat without salt and Stefansson also learned to do without it in the Arctic and like the meat better without it than with it while there.

The Nature and Early History of Pemmican, and other chapters on pemmican will be of interest to the reader.

This book is another very excellent contribution to the scientific study of diet. As such, it is of the finest contributions that this well-known Arctic explorer has made as a result of his many years of living among the Eskimos.

The reviewer would like to raise the question to what extent are meat-eating peoples like the Eskimo more free from cancer and polio than those who live on a mixed diet of meat, vegetables and fruit?

F. M. D.

CAMPBELL, BRUCE D. *Where the High Winds Blow.* New York: Charles Scribner's Sons, 1946. 215 p. $2.75.

From 1934 to 1937 Bruce Campbell worked for the Hudson's Bay Company in some of the loneliest outposts of that organization in the Eastern Arctic. It was while he was a captive of the Germans for three years and ten months dating from July, 1941 that he wrote this book describing his work at the trading posts and the life of the native Eskimo people. He had a fear of the cold barren North which he seems to have later, to a great extent, overcome.

The history of the Eskimo and origin of the name, the extent of their habitat and total world population are facts of interest.

The Northern spring, or period of light was heralded by the snow geese flying in a V-shape having come from Florida or some other Gulf-

coast state; the golden plover, a long distance flyer which had flown all the way from Patagonia—way down at the tip of South America, or the Arctic tern which comes all the way from the Antarctic—halfway round the world. The period of light, (April, May, and June), caused the people to be restess and it was difficult to get sufficient rest and sleep.

The author describes his experience of being lost in a blizzard all alone and being unconscious, only to be rescued by two natives and taken to warmth and safety. He became an expert traveler and spent considerable time visiting with the Eskimos in their camps.

I was surprised to learn that none of the Eskimo race can swim. "With utter disregard for their lives, the Eskimos venture far out to sea in their flimsy craft. They ride mountainous waves without fear, heedless of the fact that if they upset they will perish, for, curiously enough, none of the Eskimo race can swim."

The book is most suited to the adult reader.

F. M. D.

WATERS, FRANK. *The Colorado.* New York: Rinehart and Company, Inc., 1946. 400 p. $3.00.

The Colorado, illustrated by Nicolai Fechin is another book in the *Rivers of America Series.*

The content is of interest to the general reader, geographer, geologist and scientist alike. In the introduction, the character of the river is discussed. Part one tells about its background, mountains, mesa and plateau, desert and delta. Its people, padres, trappers, settlers, outcasts, and inheritors are discussed in part two. In part three, its future, the Imperial Valley, Boulder Dam, and the Grand Canyon are topics of interest.

The river is known by its one unchanging color—in Spanish the RIO COLORADO, the great Red River of the West.

"The immense drainage area of 246,000 square miles covers nearly one-twelfth of the United States and a part of Mexico. It is the most sparsely settled area of its size in the Western Hemisphere." This is country where the physical features, and not man, predominate. It contains the highest peaks, the largest mountain ranges, the widest plateaus, the deepest canyons, and the lowest deserts in America. New Mexico has the smallest water surface of any state in the Union.

He says of the Indian or red race—"it is an assumption that these people were of Asiatic stock who crossed to this continent by way of Bering Strait and slowly migrated southward. European emigrants ourselves, we cannot conceive of a race indigenous to America, still psychologically to us the New World." He traces the evolution of man dwelling in subterranean pit houses and tiny caves, then they built pueblos in the faces of cliffs, and finally the great puebos took shape upon the plains.

The Colorado River area is as much the land of pyramids as is Egypt. Here, as architecture, symbol and living form, the pyramid reaches its fullest expression. In the Mayan, Toltec, and Aztec civilizations it was a basic form.

Nearly 80 million, two-thirds of the entire population of Central and South America, is darkened with Indian blood. It is the fastest growing racial group in the country. For the next half century the expected rate of increase for white of 19%; for Negroes 50%; for Indians and Mexicans, themselves part Indian, 139%. The various tribes call themselves, "The People"; Oklahoma itself is but a Choctaw expression meaning "Red People" or simply "The People."

The Spanish, the padres, the prospectors and others came but it remained for more businesslike men to mine the gold and harness the Colorado and make it really work for man rather than forever cutting away and tearing down. But it may be that the river itself will have the last word. We measure minutes. The river ignores millenniums. It its time, the whole continent has been submerged seven times.

"And this at last seems the ultimate task to which the Colorado is appointed: to move bodily sand by sand and peak by peak, through the Measureless Millenniums man calls eternity, the whole great Colorado pyramid out into the sea. Everything is alive, dynamic with constant change."

Great tidal bores as high as 36 feet move up the Gulf of California and the silt carried down by the Colorado keeps piling up and forming a delta at the mouth of the stream.

The book is most interestingly written and will appeal to the general reader. It is an excellent book to use in the Social Studies, and in geography as a supplementary reference. Altogether it is about the best if not the best of the *River of America Series.*

F. M. D.

EMERY-WATERHOUSE, FRANCES. *"Banana Paradise".* New York: Stephen-Paul, Publishers, 1947. 260 p. $2.75.

Fourteen times the author crossed Guatemala. She learned to love Guatemala and the semitropics of S-shaped Central America. In a tussle of adjectives she describes the natives, the jungle, and the climate—its dry period, rain and heat. The botanist and those who love flowers will revel in the beauty and fragrance of flowers as they read the book. She describes many different flowers and plants as well as some of the animal life, which she incidentally learned about in the selection of a pet.

Mrs. Emery-Waterhouse is a native of Maine but her husband Russ was a soil analysist and helped establish and operate a large banana plantation on the west coast of Guatemala. This

area which they called Siguican became a "paradise" to them and like most people who live in the tropics or semi-tropics they no doubt both loved and hated it. Such experiences as the stifling heat, earthquakes, malaria and other tropical diseases account for the latter.

She describes the banana production and mentions a number of details that will be of interest to the geographer and economist.

The insect life and the snakes—unpleasant as they were, are described. The leaf-bearing ant. monkey lion, and even a gusano, a caterpillar which got under the skin below her right eye were a part of the environment she called her home for a number of years.

A good index and chapter headings, and content pages would have added to the usefulness of the book.

The author has succeeded in conveying to the reader the beauty and atmosphere of Guatemala by appealing to all five of the senses; sight, hearing, smell, taste, and touch.

Women who like to read and those interested in descriptive writing will appreciate *Banana Paradise.* F. M. D.

Lanks, Herbert. *Adventures in Central America.* Philadelphia: David McKay Company, 1947. 169 p. $2.50.

Two orphan boys about fifteen years of age, under the care of their grandfather, Colonel Livingstone, are taken on a tour of Central America. Since their grandfather is a colonel in army intelligence, the trip is just another secret mission for him. The boys incidentally do a little detective work themselves on the side, which proves to be of great interest to Dave and Dans' grandfather.

The boys experience spills and thrills as they travel, often just the two accompanied by a guide. They see pineapple, banana and coffee plantations. They explore old churches, mines and ruins.

The author, Herbert Lanks is said to be the first man to drive a car the full length of North and South America by the routes of the Alaska and Pan American Highways. He has produced motion picture films for the U. S. Government.

R. J. A.

Van Narvig, William. *East of the Iron Curtain.* New York: Ziff-Davis Publishing Company, 1946. 361 p. $3.00.

In todays news a labor leader who remarked he had read none of Marx nor Lenins' writings might profit by reading East of the Iron Curtain. In this book he would learn about Russia and why they are the "most isolationist" of all peoples and have practiced this philosophy for years and do even yet today. He would learn that strikes are not permitted in Russia and what the "secret police" really means. He would learn that communism is the rule of a select few of the many "who cannot reason why but must do and die." Russia has engaged in more wars than any other nation. Her wars have been wars of conquest and for the purpose of acquiring territory.

From this book the labor leader would learn to his dismay if he is a loyal citizen of the United States that Russia not only has designs on the destruction and overthrow of our democratic form of government. That she not only has designs but that she is actively engaged in that destruction at this very moment—using labor unions, women's clubs, youth organizations, church organizations, and every conceivable means to realize her ends which is the spread of communism (which like Nazism is forced socialism) all over the world.

Communists have positions in our government, in Hollywood, in our libraries and educational institutions, and it is from these and in these that they propagandize and spread their reactionary enslaving theories of the dictator, the benevolent despot—to through a pretense of helping the individual momentarily, gradually take away his freedom and rights until he is reduced to the serfdom of the time of Louis XIV. Russia had concentration camps and horror chambers long before Hitler.

The author takes the Roosevelt and Truman administrations to task for their playing up to Stalin and appeasing him. Roosevelt admitted that Stalin and Russia have failed to keep their word and to keep faith with the United States. Hitler was no man to do business with, and neither was Stalin, and most people in the United States realized that all along. Had the administration adhered to that fact we would not find ourselves in the embarassing position we do today.

The headline in the news today says that capital weighs new spending in the Balkans to halt communism. Every intelligent American knows communism will not be halted by spending neither will it bring us good-will. Experience has proven it hasn't. How we fight communism in our own United States and how we carry on our own government and economic and industrial affairs is the chief weapon we have against communism. And it is that weapon and that alone that will succeed. The United Nations may only be a step in the wrong direction, who knows? The veto gives Russia the power to veto any act, so she sets herself up, and has been permitted to set herself up, as the sole judge of any act passed.

All alert Americans realize that Russian Communism and Russian Imperialism now march hand in hand are are bent on territorial expansion and subjugation of peoples.

Is this problem any less serious to the best interests of the United States than Nazism and German domination prior to the war? Have we "bitten off more than we can chew?"

F. M. D.

Moorad, George. *Behind the Iron Curtain.* Philadelphia: Fireside Press, Inc., 1946. 309 p. $3.00.

In the introduction to this book written by W. L. White, he again reminds the reader of

what so many already know; how difficult it is for American correspondents to get permission to report facts about Russia. If they dare to describe it as it actually is, they may not be permitted to ever come into Russia again. There are fellow traveler reporters and fellow traveler newspapers who let the Soviet tell them how and what to report back to the U. S. Moorad is not of their class says W. L. White.

All of Russia's European policy is built on the belief that a Western Capitalist bloc will arise against her. That is why she devotes every effort to disrupt Western Unity. They know England, France, and the United States will stand together.

The author states that the death of President Roosevelt struck Russia with numbing force.

General Patrick Hurley told the author to "tell the Americans that you cannot bank goodwill with the Soviets. Each deal is complete in itself; there is no credit carry over. I've seen Russians attend a cocktail party given by Americans to celebrate Soviet acceptance of twelve thousand trucks, and the very next day those same people refused to help your embassay acquire a small unused building for additional space.

"If Americans can understand some of these things, and mix generosity with good stiff resistance on vital issues all along the line, then we can gradually arrive at tolerable relations. If they know the truth in America and are prepared to maintain their rights before the Soviets advance too far, then I think there is no need for anxiety. People may as well get the truth. God knows they've had everything else."

Some chapters which may be of special interest are: The Soviet Woman, Russia Fights with Food, Needed: Twenty-five Million Homes, and What do Russians Think?

F. M. D.

PUTMAN, GEORGE PALMER. *Death Valley and Its Country*. New York: Duell, Sloan and Pearce, Inc., 1946. 231 p. $2.75.

Famed Death Valley attracts a large number of visitors annually, but it is still "long on distances and short on population." From this interesting little book one can learn whom Scotty really is; what was in all probability his gold mine and not to travel through Death Valley.

The book is written in an interesting style and here and there a tall tale told by Scotty or someone is added. Read about the burros, and mountain sheep and about the little people of the desert such as the pack rat. How does Death Valley compare with other low, dry, hot places in American and other parts of the world? In spite of the heat and dryness, the plant life in the Valley is colorful and rare.

No book about Death Valley would be complete without the heroic story of the '49ers and their trying experiences as they crossed the valley on their way to California in search of gold.

F. M. D.

Recent Changes in Science Positions

W. Hugh Stickler from Stephens College, Columbia, Missouri, to Chairman of General Education, University of Florida, Tallahassee, Florida.

Robert H. Carleton from School of Engineering, Newark College, Newark, New Jersey, to Michigan State College, East Lansing, Michigan.

Robert Jay Stollberg from Department of Physics, Wabash College, Crawfordsville, Indiana, to Purdue University, Lafayette, Indiana.

Nathan A. Neal on leave from Board of Education, Cleveland, Ohio to Harper and Brothers, Publishers, New York, New York.

Warren Everote from Encyclopedia Britanica Films, New York City, to Encyclopedia Britanica Films, Wilmette, Illinois.

J. S. Richardson from Miami University to College of Education, The Ohio State University, Columbus, Ohio.

J. Darrell Barnard from Head of Science Department, Colorado State College of Education, Greeley, to School of Education, New York University, New York City.

Cyrus W. Barnes on leave from New York University.

F. Atherton Riedel from government service in England and Germany to Oklahoma A. and M. College, Stillwater, Oklahoma.

George J. Bergman from Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, New York City, to Department of Biology, State Teachers College, East Stroudsburg, Pennsylvania.

R. Will Burnett from San Francisco State College, San Francisco, Calif., to College of Education, University of Illinois, Urbana, Illinois.

Karl F. Oerlein from Military Service to Head of Training Manuals Division, U. S. Naval Reserve Training Publicatons Project, Naval Gun Factory, Washington, D. C.

E. L. Grove from Parma, Ohio, to State Teachers College, St. Cloud, Minnesota.

W. Edgar Martin from Ann Arbor, Michigan, to Moorhead State Teachers College, Moorhead, Minnesota.

George W. Mallinson from Ann Arbor, Michigan, to Iowa State Teachers College, Cedar Falls, Iowa.

Cyril H. Hancock from Visual Aids Director to Principal, Great Falls, Montana, High School.

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